ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXIII. No. 18.

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ENGINEERING NEWS.

THE TWO-AMERICAS RAILWAY PROJECT has been reported upon by a committee of the Pan-American conference. The committee recommends the appointment of an international commission of engineers, three appointed by each nation, to study the possible routes, determine their true length, estimate the cost of each and compare reciprocal advantages.

At the present time the City of Mexico is distant from New York, 3,680 miles, via El Paso and the Mexican Central R. R., and 3,026 miles via Laredo and Mexican National Railway. A line is in operation 183 miles south of Mexico, and a concession granted for its extension 585 miles further to the borders of Guatemala. A line is also being surveyed for an extension from the border to the City of Guatemala, 150 miles. Lines are projected through Salvador and Honduras, and Nicaragua has a railway system 90 miles long. About 35 miles of an existing Costa Rican may be used in the 210 miles through that State. But in all 1,700 miles of railway would have to be built to carry the route from the City of Mexico through Central America, of which only 295 miles are in operation, and 780 are being constructed or surveyed; 625 are yet to be located.

In the extreme South, the railways of the Argentine Republic are within 120 miles of the Bolivian border and concessions have been granted for lines to connect with the railway systems of Bolivia and Peru. With these lines built there would be a line 2,190 miles long, from Buenos Ayres to Cuzco, in Peru. Beyond Cuzco, northward to the railways of Costa Rica, a line 2,300 miles long would be required, on which practically nothing has been done. In fact, between Mexico and the northern terminus of the Argentine railway system, a distance of 4,900 miles, there are only 230 miles of railway in operation. It is hence evident that the starting of the Terra del Fuego express will be somewhat delayed.

THE PEAKS OF IXTACCIHUATL AND POPOCATAPETL in Mexico are to be made accessible to tourists, as far as granting a concession to connect them with the Inter-Oceanic Ry. will further such a scheme. As the latter mountain is 17,800 ft. above sea level, or about 10,000 ft. above the Mexican tableland, some heavy engineering work is here contemplated. Work must be commenced a year from date and the road completed within 5 years, with no pecuniary subsidy.

THE METRIC SYSTEM, for foreign mail service and custom imports, was advocated at the last meeting of the American Metrological Society, held in Washington, D. C., on April 22. For post office use it would prevent unnecessary complications in handling foreign mail. And there is wisdom in the argument of the Society that the meter and kilogramme should be introduced into our tariff bill, along with, if not substituted for, the yard and pound. There are now 24 nations using the metric system and so invoicing goods; while no other nation, not even England, has exactly the same system of weights and measures as has the United States. As the committee states, very much totally unnecessary labor, and possible error, could thus be saved our customs officers in figuring out equivalents.

THE SUBJECT OF AUTOMATIC BRAKES AND COUPLERS for freight cars is now before Congress, bills concerning their compulsory use having been introduced into both the Senate and House. The Senate bill was introduced by Senator CULLOM, and provides for the appointment of a commission to investigate the various couplings and safety appliances for freight cars and to submit a report on the subject to Congress. The commission is to consist of three practical railroad men and two mechanical experts. It is intended that upon their report and recommendation some uniform type of coupling shall be adopted.

THE WESTINGHOUSE AIR BRAKE CO. has made arrangements with the Vanderbilt system to put its air brake on every freight car on the entire system. The company has a similar contract with the Pennsylvania Railroad system and the Chicago, Burlington & Quincy line.

A TRIAL OF RAILWAY AUTOMATIC CONTINUOUS BRAKES is to take place at Adelaide, South Australia, in September, 1890. This is in accordance with a resolution of the House of Assembly to appoint a board of experts to inquire into the respective merits of the Westinghouse, Vacuum and other brakes. The chairman of the board is L. GRAYSON, M. P., and the board publishes in London *Engineering* the full conditions of the test.

COKE AS A LOCOMOTIVE FUEL is still being experimented with on the Baltimore & Ohio with good results. Six engines on the Philadelphia division and two on the main line now burn coke exclusively. Coke is as clean a fuel as hard coal, and it is claimed to cost on the B. & O. less than one-half as much, and the cost of converting soft coal engines into coke burners is less than to prepare them for hard coal. The grade of coke which has been found to answer best is that which has been burned for 36 hours.

THE WORST ACCIDENT OF THE WEEK, not a very bad one, but a very curious one, happened to a run-away vestibule train on the Chesapeake & Ohio R. R., April 28. The train was two hours late, and consisted of five day coaches and two sleepers. On a heavy grade west of Staunton, Va., the train in some unexplained way become uncontrollable, and had attained a speed of 70 to 80 miles an hour when the rear sleeper careened, tearing up the platform and station building and completely shattering the car. One person was killed and six injured. The rest of the train passed on uninjured, but was not controlled till it had passed on to an up grade. The press reports state that "the brake rod of the engine fell and the air brake was rendered useless," which of course is nonsense. We cannot understand from the records the real cause of the runaway.

A MIRACULOUS ESCAPE FROM DEATH occurred at Lynn, Mass., April 21. WILBUR BOUTELIER, a lad of seven, attempted to cross the tracks of the Saugus branch of the Boston & Maine R. R., when he was struck by the train and hurled into the air. The engineer of the train closed the throttle as quickly as possible and alighted, convinced that the boy had been killed. Upon looking for the corpse, they found the urchin unharmed except by a slight bruise over the eye, and seated on the cow catcher, where he had landed on his descent after being thrown in the air by the engine. He had been carried nearly 300 ft.

THE MORGANZA CREVASSE, of April 22, is the most serious result yet of the floods of 1890 in the Mississippi Valley. This levee broke in 1874 and again in 1884, but was rebuilt at once by the State of Louisiana. The new work, which was deemed the finest in the State, has held, but the old levee immediately adjoining it has given way in two places, 1,500 ft. and 700 ft. wide and 26 ft. deep and widening daily. The break will flood from 1,500 to 2,000 sq. miles of land, mostly swamp. The broken levee was about 26 ft. high, 14 ft. wide on the top and 200 ft. wide at the base. Capt. KINGMAN estimated the discharge through the 1,500 ft. opening at over 150,000 cu. ft. per second.

A LANDSIDE at Livermore, Cal., occurred just as a train was passing (as they are most likely to), on April 20, completely burying the engine and baggage car. The slide covered the track 10 ft. deep for 300 ft. A street landslide of filled ground on a side hill occurred in Pittsburg.

BRIDGE FAILURES reported are as follows: The Pease River bridge, at Vernon, Texas, lost 500 ft. of iron spans by washing out of foundations in an unprecedented flood.——A bridge on the Louisiana Central Ry. was washed off its abutments and jammed into a Texas Pacific bridge just below, which stood uninjured.——A number of highway bridges have been washed away in Louisiana and Texas.——In California, a severe earthquake threw the Southern Pacific bridge, at Gilroy, nearly a foot out of line at each end, interrupting traffic. The piers, which are 60 ft. high, swayed and settled a few inches.

THE ST. CLAIR TUNNEL, on April 26, had been driven 3,646 ft. out of the total of 6,000 ft., 2,028 ft. of which has been driven since Jan. 1 last. This is an average progress of 20.28 ft. per working day in the two headings, or slightly over 10 ft. per day in each heading.

THE CHANNEL TUNNEL was inspected last month by the English Board of Trade. They found a heading 6,000 ft. long practically free from water, well ventilated, and the boring machinery in such good condition that it was put to work to show the visitors how easily the hole was made. It seems passing strange that in the face of the presentation of several enormously costly and difficult schemes for bridging, the tunnel the easiest method of all is ignored, simply on account of a very silly fear of a possible French invasion.

A PROPOSED WATER POWER IMPROVEMENT at Bridgeport, Conn., in charge of Mr. B. H. Hull, C. E., is to divert the waters of Mad River, about three miles above Winsted, by constructing a dam, and thence by a canal 2,000 ft long, to convey the water into Rugg Brook Valley. By constructing a dam across the valley at a point near the discharge into Mad River (a narrow gorge), a reservoir of 70 acres will be created, with an average depth of 20 ft. Two side dams of earth are to be constructed, and from the Rugg Brook Valley a tunnel will be made through the mountain, 4,000 ft. in length. It will take from one to two months to get all the survey and plans prepared for work.

THE BEAR VALLEY ARCH DAM in California is to be tested as to its supposed change of form when relieved from the water pressure, in accordance with the recommendation of the American Society of Civil Engineers. A new and higher dam is to be built and the old reservoir is to be emptied, thus affording the opportunity desired. The Technical Society of the Pacific Coast will have charge of the experiments and has appointed for this purpose the following committee: Messrs. E. G. MALERA, ROSS E. BROWNE, Prof. FRANK SOULE, LUTHER WAGONER and L. N. CLEMENT.

THE CABLE RAILWAY BILL, whereby 70 miles of New York streets were to be handed over to the New York Cable Ry. Co., was killed in the Senate on April 25 by a vote of 15 to 10. The Senate Judiciary Committee reported favorably Senator CANTOR'S bill validating the contract of the Broadway Surface Ry. Co. with the City of New York to bear its share of repairing Broadway, and to pay $150,000 yearly to the city as compensation for the privilege of putting a cable railway on Broadway. There seems to be no opposition to this bill.

THE DOCK COMMISSION INVESTIGATIONS, started in this city on a partisan basis and vigorously pushed on similar lines, has ended in the dismissal of the charges against them by Mayor GRANT. While the testimony brought out disclosed a certain looseness of administration on the part of the commission, which could no doubt be improved

upon, the charges made against Chief Engineer GREENE, in regard to the engineering methods of the department, have been proven utterly groundless.

EVERYONE who knows President HENRY MORTON, of Stevens Institute, will appreciate the following incident:

At a recent meeting of the New York Board of Electrical Control, Expert SCHUYLER S. WHEELER gave an account of the discouraging results in the electrical subways exposed to the heat of the New York Steam Co.'s pipes. He said that he had a report on the matter prepared by President MORTON, of Stevens Institute, and in response to Mayor GRANT'S question stated that it had been submitted by one of the electrical companies. "You can stop reading," said Mayor GRANT. "I would not give a snap for such a report. I am astonished that you should submit such a one."

Of course the reporters took note of the Mayor's explosion, and his doubtless rather hasty remarks were published. On the following morning, under the very appropriate heading, "The Retort Courteous," President MORTON made the following reply:

To the Editor of the New York Times:

I read in some of the morning's papers the disparaging remarks attributed to Mayor Grant in reference to my opinion as to the insulation of electric wires with some surprise, because I should have expected that professional courtesy among experts would have led his Honor to treat my opinion as to the insulation of wires with as much respect as I should have given to his opinion concerning the pulling of the same. HENRY MORTON.

THE TELEPHONE SERVICE OF GERMANY, on Oct. 1, 1889, extended to 176 towns, utilizing altogether 39,876 telephones and 35,653 miles of wire. The average number of "calls" per day over this system was 581,839. The total service employs 3,288 attendants of all classes.

THE GERMAN OUTPUT OF PIG-IRON FOR 1889 is given by the German association of iron and steel makers, as equal to a total production of 4,387,504 tons of 2,200 lbs.

THE EIFFEL-EDISON TOWER, proposed for the Chicago World's Fair, it is reported, will be about 1,500 ft. high. Messrs. EIFFEL and THOMAS A EDISON are to unite in the enterprise, and rumor has it that the latter gentleman is to place upon it a million multi-colored incandescent lights. This is a possible combination of loftiness and startling effect that ought to satisfy even Chicago.

THE JUDSON SYSTEM OF STREET CAR TRACTION is to be applied in Washington, D. C., on a road which is to run from the Boundary, at Seventh St., to Rock Creek Church road. This is the system already fully described in this journal, whereby a revolving tube in a conduit transforms its motion into a longitudinal one by means of rollers attached to the car. Compressed air is used as a motor for the tube.

A PARCELS POST, by coach, has been started by the English post-office authorities between Liverpool and Manchester. The horses are to be changed twice in the 35 miles, and the distance is to be run in 5½ hours. There is a growing belief in England that, under certain circumstances, parcels can be carried more economically in this way than by rail. The railway authorities charge 55 per cent. of the gross postage for their expenses; and as these charges are practically as heavy for short as for long distances, up to a certain mileage the coach is found cheaper. The parcels post is, in fact, only an extension by the English post-office of the present system of suburban delivery, which, in private hands in London, has almost a monopoly of parcel delivery.

The Facts as to the City of Paris Mishap.

[FROM OUR LONDON CORRESPONDENT.]

Since I wrote my last note on the *City of Paris*, I have made a run to Liverpool for the purpose of examining the state of the ship and inquiring into the cause of the breakdown of the engine on the spot.

Upon arriving at Liverpool I found the ship had been dry-docked on the Birkenhead side of the Mersey, and I immediately started for the vessel armed with full authority to see and find out everything I could. I must here pause to say a word as to the great courtesy with which I was received by Messrs. Richardson, Spence & Co., the managing agents for the Inman and International companies. I had anticipated that my run to Liverpool might have turned out a fruitless errand, as there had been mention in the papers of the secrecy observed by the officials of the company.

Mr. TAYLOR, the acting manager of the firm, was, however, but too glad to have an engineer, and the representative of an engineering journal, which would speak to the American public with authority, inquire into the matter. That there has been an accident, and a very big accident, too, there is of course no denying; but bad as things are, they are made far worse by the lying reports of ignorant and sensation-hunting newspaper writers of the baser sort.

On arriving at the graving dock in which the "*Paris*," as she is familiarly named, was lying, we found the noble ship outwardly none the worse for her mishap; with the not unimportant exception that she had dropped her starboard propeller and its outboard shafting into the bottom of the dock. You have heard generally of the universal smash of the low-pressure starboard engine, so I will begin at

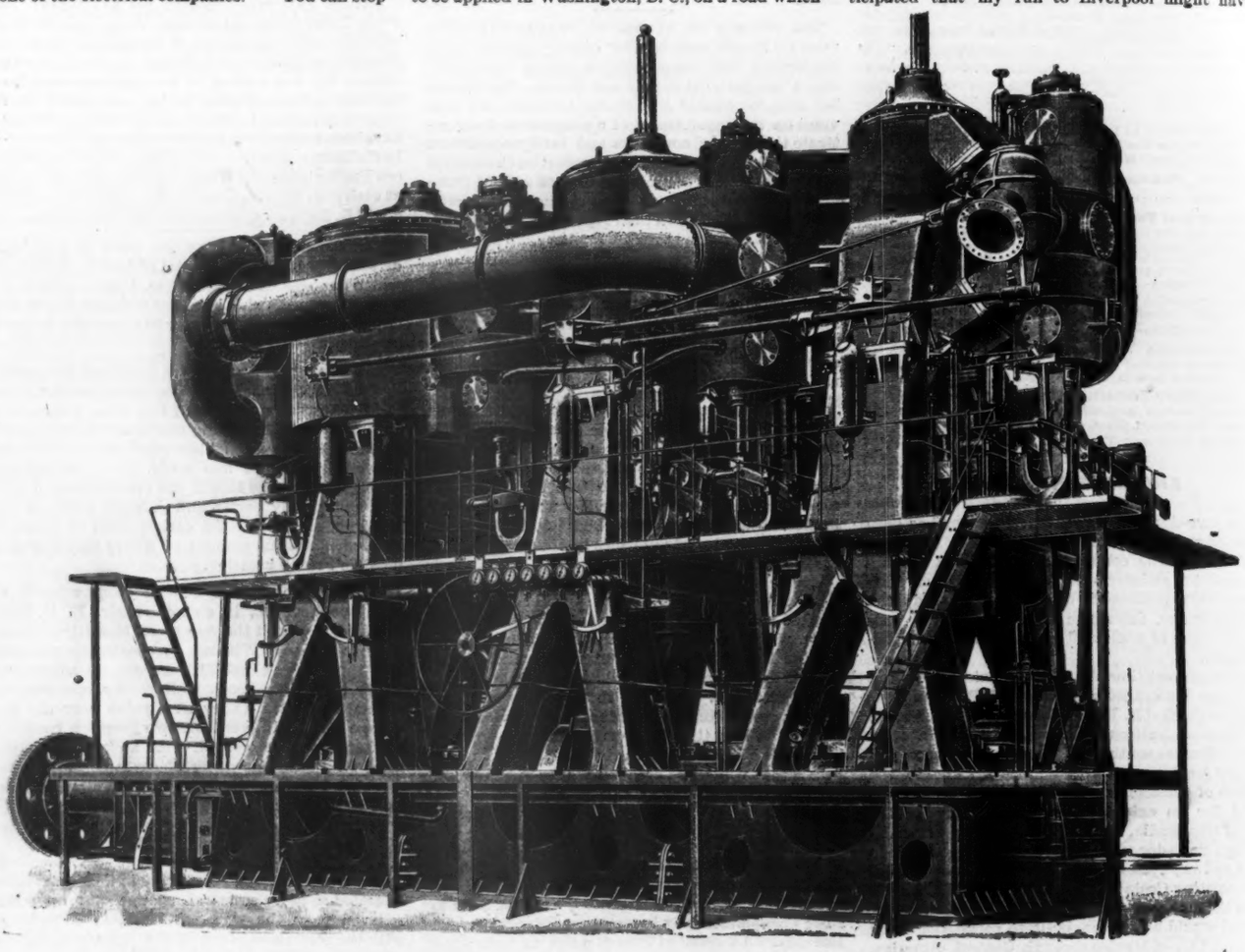


Fig. 1.—The Engines of the Inman Steamship "City of Paris." Messrs. J. & G. THOMSON, *Engineers*, Glasgow.

[The grated footway which is so conspicuous in Fig. 2 is not the one which appears in this view, but passed around near the tops of the cylinders above the large steam pipe. The low pressure cylinder and engine only was destroyed. The high pressure and intermediate cylinders still remain substantially intact.]

the beginning and follow up the cause of accident from its inception.

The *City of Paris* is, as every one knows, a twin-screw vessel; but it is only with the starboard side that we have to do in the present connection. The three-bladed propeller is carried on the end of a propeller shaft 6 ft. long, and this in turn is coupled to a length of outboard shafting 30 ft. or so long. The 6 ft. of propeller shaft is supported throughout its length in the barrel of the stern bracket. This stern bracket consists of two arms attached, one to the heel of the stern post, and the other to the skin plating higher up. These arms project from the vessel and converge towards each other, being joined at the point of meeting by the sleeve or barrel shaped part of the bracket. The two arms and sleeve forming the stern bracket consist of one steel casting. Those who are acquainted with the arrangement of supporting twin screws will recognize this as in conformity with the most usual practice. The outboard length of shafting is inclosed in a casing of steel plating, and this plating is attached for a great part of its length to the ship's side by means of a steel web. The shafting emerges from the skin of the ship through a stern tube in the usual way. It is necessary that these points should be made clear in order that the nature of the accident may be understood, for I may as well at once say that the seat of the evil existed in the propeller shaft and its bearings. Perhaps it will be as well to give the arrangement of shafting, tracing it from the engine. As we travel aft the first thing we come to is—or rather was, but of that anon—the thrust-block. The shaft then passes through the after engine room bulkhead and enters the dynamo room. Beyond this is the shaft tunnel, which runs to the place where the shaft passes through the ship's skin plating. There is, of course, here a stern tube, and immediately outside the stern tube—*i. e.*, when the vessel is afloat—there is one of the flange couplings which is used for joining the lengths of shafting together. Between the after end of the stern tube and the sleeve of the bracket there is a length of shafting, and this, of course, has a collar at each end in order to form the necessary couplings. The propeller shaft—*i. e.*, the extreme outermost length of shafting—which is, as stated, 6 ft. long, runs wholly in the sleeve of the bracket, and is therefore a journal throughout its length.

When the ship was docked, and the casing was taken off of the outward length of shafting, the whole fell down into the bottom of the dock, carrying the propeller shaft and propeller with it. As the propeller shaft, however, was enclosed in the sleeve of the casting, it will be evident that the latter had to be broken in order to allow the shaft and propeller to fall. Upon examination, it was found that the shafting had been broken off clean across, in a plane at right angles to its axis, immediately outside the stern tube. That this fracture was done at sea there can be no doubt, for both surfaces were thick with rust, which must have been the result of some days' immersion when in salt water. If I have made my description clear, it will be seen that the fracture was just forward of the coupling, which is immediately outside the stern tube, *i. e.*, the coupling which connects the aftermost length of the tunnel shaft with the outboard shaft. So close was the breakage of the collar that it takes in a part of the fillet. The diameter of the shaft is about 20½ ins. It is made of solid steel, by Vickers, of Sheffield, and is sound throughout.

Fig. 2.—Wreck of Starboard Engine, "City of Paris," After the Accident. Looking Aft.

[From a photograph.]

The accident was not due to any fault in the shaft itself, either on account of material or dimensions, and to find the cause of the evil we must travel further aft.

It will be remembered that the 6 ft. length of propeller shaft is carried in the cylindrical part of the stern bracket, and that this cylindrical part had to be broken before the shaft would be released. It is broken—split along its top side from end to end through the 3½ ins. of steel. The fracture, when I saw it in the dock, was perfectly bright, showing that it had been caused by the leverage of the unbalanced length of outboard shafting which had been released by the casing being cast adrift, in order to see whether the shaft was intact. The propeller, it may be stated, was uninjured until its fall into the bottom of the dock.

I have said that the cylindrical part of the bracket was split along its top; but it will be evident that in order to release the shaft there would have to be more than a single crack, and indeed one-half of the barrel was lying in the bottom of the dock. There was only occasion, however, for one fracture, as the bottom part of the barrel, or cylindrical part of the stern bracket, was ground away right through the metal. The bearing for the propellor shaft was formed by a brass or gunmetal liner, 1 in. thick. This was also lying in the bottom of the dock, a part of its circumference being entirely ground away throughout its length. The metal bushing of the shaft had entirely disappeared; nothing but a couple of rings, which had apparently formed flanges at the outer ends, remaining; and the propeller shaft itself was ground down to considerably less than its normal thickness.

Here, then, was the original seat of the disaster to the *City of Paris*. A grinding action had been set up between the journal of the propeller shaft and its bearing within the stern bracket. That grinding had worn through the inch metal of the liner and then through about 3½ ins. of steel, composing the bracket casting. This would give a drop of the end of the shaft of 4½ ins.; but to this we must add the wear of the shaft and its bush, which might have been a little more or a little less; I had no means of ascertaining. We should, however, be probably safe in estimating the total drop of the propeller at 8 ins.; and it is unnecessary to go further to account for the fracture of the outboard end of the tunnel shaft.

It will doubtless be asked why the bearings wore away in this extraordinary manner; but here we come to the region of conjecture. There is a government enquiry to be held on the cause of this accident, and I would not wish to prejudice it in any way by hazarding theories which I might not be able to support in the light of fuller information. An examination of the sister bearing on the port side would give some valuable information. This bearing has, so far as outward indications go, every appearance of being sound. It should be stated that there is a second fracture in the outboard shaft, but this has been caused by the falling to the bottom of the dock, although there are some trifling indications of rust here.

We will now proceed on board the vessel and examine the state of affairs inside. Had the giant Thor brought down his fabled hammer with one of its mightiest whacks right on the apex of the low-pressure cylinder of the starboard engine of the *City of Paris* the utter smash-up of that engine could not have been more complete. Here are a few of the chief items in the inventory of the débris lying in the bilge: Two halves of one 113-in. low-pressure cylinder casting, weighing 45 tons each, with two piston valves and valve castings attached. One steel low-pressure cylinder cover, with a large part of one side broken off. One cast steel, low-pressure piston of dished type, broken in two chief parts; weight, 10 tons. Several large pieces of cast-steel engine framing. Two main bearing caps, split right across, one connecting rod, crosshead and piston rod, weight, 12 tons, still attached to crank. Four feet of fork of cylinder pedestal still attached to bed-plate; three feet of the corresponding fork still attached.

Perhaps, however, the most striking part of this scene of desolation was the smaller components of the débris. How floor plates, framings, castings and forgings of iron and steel could have been smashed into so many fragments without being passed through some mammoth mill is a puzzle to imagine; but our surprise in this respect yields to the wonder we felt at all this pounding and pulverizing taking place on so frail a structure as the bottom of a ship without the whole mass going through to the bottom of the ocean. As a matter of fact, the outer skin of the *City of Paris* has never been pierced, and had the inlet and outlet valves to the condenser been closed in time not a drop of water would have entered the ship.

Proceeding through the engine room and dynamo room, we get to the shaft tunnel, and at the after

end examine the stern bearing. Here I found no sign of injury, but it must be remembered that the light in a shaft tunnel is never of the most brilliant description. There are four bearings in the tunnel, and each of these had its cap forced off or split. The steel plate end of the tunnel, through which the shaft passes, has been torn on the part above the shaft. There are two bearings in the dynamo room, and the caps of both of these have been broken off, whilst the bulkhead separating the engine and dynamo rooms is also split above the shaft. The thrust bearing has been served in a similar manner to the line bearings. It is of the new type, with loose collars of horse-shoe type and having (presumably) water service. The loose caps were distributed among the débris of this part for a considerable distance.

Of the engine proper—and my remarks only apply to the low-pressure engine, the other two cylinders standing still in place—the highest part standing above the wreck is the jagged fracture of the casting which forms the pedestal of the port side frame. The crank is of the built-up type, the webs being shrunk and keyed on to the shaft. The crank is on top centers, with the connecting rod attached. This connecting rod weighs 7 tons, and is bent a foot out of the straight. It lies horizontally, pointing to the starboard side, so that the cross-head lies just under the king bulkhead. Attached to it there is still the piston rod, which is doubled back again on the engine; but the tail rod end has been bent very nearly at right angles to the other part, so that the end points aft. I fell into the crank race, and whilst there I examined the state of the crank. The two webs have been both shifted forward a trifle, less than a quarter of an inch; but what must have been the force to effect this, it almost passes one's comprehension to imagine. On the crank, crank-shaft; engine framing, and connecting rod there are dents and scores innumerable; in fact, there is hardly an important piece which does not show evidence of having been subjected to a shower of heavy blows; some pieces have been battered quite out of recognizable form. On the end of the web of each crank the metal has been scooped away to the depth of an inch or so; the transverse parts of the engine base have been split right across, the main bearing caps are gone, and one of the steel bolts, nearly 6 ins. in diameter, has been broken off flush with the engine base, the companion bolt being bent. The weigh shaft for working the valve gear is broken away and bent down, this to a certain extent involving some damage to the intermediate and high-pressure engines. The inner skin of the double bottom is broken through; but, as the outer skin of the ship remains intact, all the damage we have described might have taken place and yet the *City of Paris* would have been able to proceed comfortably enough on the voyage at somewhat reduced speed by the aid of her port engine, and without a drop of water on board above her normal requirements, had it not been for a phase of the accident, which I have not described.

The engines of the *City of Paris* have cast-steel standards alike on back and front; that is to say, the condenser does not form part of the framing after the manner of the majority of mercantile surface condensing engines. The condenser itself is of the cylindrical form, after the navy type. It lies in the outer wing of the engine room beyond the air pump, or, rather, the position the air pump once occupied; for that piece of mechanism has disappeared from view, being buried beneath the fork of a 7-ton connecting rod and its 3-ton crosshead and attached piston-rod end. When this mighty flail got free from the cylinder, its first act was to demolish the two 14-ton cast-steel frames. As it was swung about by the working of the crank, it punched with its free arm—the end of the piston tail rod—two holes in the fore and aft engine room bulkhead, and then, probably as its last act, disemboweled he condenser, bursting through its skin and making a gash, through which its tubes protruded, big enough to take in a donkey and cart.

It was here that the water rushed in which flooded both engine rooms and disabled the ship. What would be the volume of circulating water which would be required to condense the steam of the engine would require but a simple calculation to find out had we the I. H. P. of the engine; but at any rate, it must be a considerable flood. We believe there are two 20-in. inlets, and there must be a corresponding outlet. As the circulating pumps are of the centrifugal type, the water from the sea could flow through them; and it did flow through—and through the outlet, too, presumably—to the extent of flooding the port engine compartment in less than ten minutes, while the starboard engine-room was filled in a somewhat longer period of time, some say half an hour.

In what sequence the engine broke up will never be known with certainty. There were, when the smashing began, seven of the ship's company in the engine room, and two men in the dynamo room; although the two latter may be included in the total of seven. On this point my information is somewhat conflicting. How these men escaped without injury, excepting in one case of scalding by steam, is no less a marvel than many other parts of this wondrous tale of danger and escape. They must have jumped like monkeys and certainly could not have stopped to take notes(!) We can imagine how the engine raced away when suddenly relieved of the load of perhaps 9,000 I. H. P. when the shaft broke. We may picture to ourselves the piston breaking from its rod at the bottom of the stroke and then flying up to the top of the cylinder, bursting off the cylinder cover, and the two flying upward and battering in the steel plating of the engine room space, thus causing the bulges and dents now to be seen above the upper deck level and far beyond the highest point of the engine Some part of this flying débris of steel castings, one piece at least over 10 tons in weight, must have fallen into the crank pit, and as the crank pounded down onto it—scooping out the hollows in the solid steel web already referred to—the crank shaft was pried up in its bearings, the bearing caps were forced off, and the bulkheads were torn as before pointed out. When the cylinder was rent in twain it is more difficult to form an idea. Whether it was the same shock that broke the piston from its rod, whether the piston got jammed as it was shot out like a projectile, or whether some other incident in the catastrophe was responsible for this action may perhaps be more fully determined when the evidence of the débris is pieced together. One thing, however, seems pretty evident: that the connecting rod and piston swung about with all the force of its 12 tons during at least two revolutions of the crank, or else why the two holes in the transverse bulkhead?

It is easy to be wise after the event; to sit here comfortably with pen in hand, and leisurely point out what ought to have been done; but at the risk of having this cast in my teeth I will draw what appears to me one or two obvious morals.

There are valves fitted to the condenser sea connections. These are worked in the usual way by wheels close to the valves, and, therefore, on the lower flat of the engine room, right down on the ship's bottom. A line of vertical shafting, and a few pair of beveled wheels would have enabled these valves to be closed from any of the upper decks; if need be, almost in the very cabin of the chief engineer. Might not such an arrangement be fitted to steamships in future, although the practice is not in vogue now? The condenser is, after all, but a slight and fragile thing to be between life and the deep sea. We know of one instance, in a vessel of Her Majesty's navy, in which a trial was stopped, simply by a man sitting on the condenser—it was only a torpedo boat. The man's weight pressed the cylindrical casing out of its form of greatest strength, and the atmospheric pressure (for there was a good vacuum at the time) caused the whole thing to collapse. Of course, there is a great difference between the scantling of the *City of Paris*' condenser and that of a little torpedo boat; but a moral may perhaps be drawn.

Since the introduction of the three-crank triple-compound engine, marine engine governors have gone much out of fashion. Engineers, or perhaps owners, who pay the bill, say that the more equal turning moment, due to the work being distributed between three cranks, renders the governors unnecessary. After the accident to the *Paris* I should think the marine engine governor trade, which has been very slack for a year or two past, would be looking up again. Probably, however, a governor would not have done very much good in so extreme a case as that we are considering; but my second suggestion would be that in cases where governors are not fitted a man should be told off to sit throughout his watch with his hand on the steam stop-valve. It would not be a large item in comparison to the whole cost of running such a ship as the *City of Paris*; but it may be thought by some to be almost as necessary a precaution as having a double look-out in the bow on deck.

Another suggestion has already been made, namely, that such vessels should carry a diving dress. The bulkhead holes were but small things to stop, even if the circulatory water valves could not have been reached. The divers soon dealt with this matter when the ship got to Queenstown.

The accident to the *City of Paris* is the biggest thing in marine engine break-downs ever recorded. There is some element in human nature which makes us almost as proud of our misfortunes as of our virtues; which, I suppose, is the reason Americans tell us, over here, so often about the Chicago fire, alongside which our own fire of London, two hundred years ago, was a mere flash in the pan—the big railway accidents, the mighty floods and other mammoth catastrophes, which we cannot match in our little Island. I don't know whether the *City of Paris* may be considered most English or American, so far as ownership is concerned, but she was certainly British built, and as the accident occurred nearest to British waters, we may, perhaps, be allowed to add it to our list. America will have to do a very big thing before she breaks the British record in this field.

The safety of the vessels which ply on the Atlantic ferry is of such vital importance to both sides that, perhaps, I may be allowed to add a few more words to this already long account. At no time does one get an opportunity of judging of the merits of an engine as after such a smash-up as that of the *City of Paris*. It is to the engineer what a post-mortem is to the physician; and more, for if there is a bad place in an engine, it is sure to be there that the fracture will occur. As the result of a pretty thorough investigation, I was unable to lay my finger on a single bad piece of material, or to point a single instance in which efficiency had been sacrificed to cheapness of cost, Wherever there was a fracture in a casting, there the metal was shown to be sound and good; in fact, the excellence in this respect should do much to establish confidence in steel castings, as showing that they *can* be made sound. The broken shaft had every appearance of being a sound job; and, in short, the same may be said of the ship and engines throughout. The only point to clear up is, why the propeller shaft wore down its bearings.

American readers need not be reminded of the Deacon's one-hoss shay. The destruction of the low-pressure starboard engine of the *City of Paris* was no less complete than that of the world-renowned vehicle. [We give a view of the wreck, for which we are indebted to *The Engineer*, and a view of the engines as built, for which we are indebted to *Engineering*.—Ed.]

Master-Key Locks.

Master-key locks have been introduced by the Yale & Towne Manufacturing Co., of Stamford, Conn., that are as great an improvement on older devices of this kind as were the Yale keys on the clumsy articles previously in common use. Instead of making a master-key on the ward or lever principle, as of old, which impaired the security of the lock, complicated the mechanism and admitted of comparatively few changes, any number of locks, of the same or different sizes, can be here provided with one master-key. This is only made possible by the tumbler mechanism and general design of the well-known Yale locks.

The essential feature of the "duplex" system lies in providing each lock with two separate escutcheons on each side; the lower escutcheon contains the same tumbler mechanism throughout the system of locks used, and one key will separate all of them. The upper escutcheons operating on the same bolts, are set to and require different keys for each lock, or may be subdivided into series in the general system of locks. This duplex system is an almost absurdly simple solution of a problem that has engaged the attention of lockmakers for centuries. But it is the compact and ingenious scheme of the Yale lock that makes so easy the solution. Not the least advantage is that one master-key can be made to open street and closet doors in the house, the office door and the desks down-town, or in fact any article that needs a lock.

Statistics of Railway Construction.

MEXICO.

Existing Roads.

1. ***Interoceanic.***—Track laid in 1889, Nonacamilpa to Puebla, 47 miles; Vireyes to Parote, 29 miles; Yantipec toward Amacuzac, 17.36 miles; Vera Cruz toward Perote, 6.2 miles. Track laid since Jan. 1, 1890, Perote to end of track, 30 miles. Under construction between ends of track, 40 miles; Nonacamilpa to Calpulalpam, 10 miles; Acapulco to Atlixco, 175 miles. Projected: San Juan de Los Lanos to Teziutlan, 40 miles; Chietla to Cautla Morelos, 42 miles; Yauntepec to Cuernavaca, 17 miles; Soapayuca to Pachuca, 34 miles. Superintendent, D. De Peon Gensal, 14 Calle de San Augustine, City of Mexico.

2. ***Mexican.***—Under construction: Ometusca to Pachuca, 30 miles. President, Robert W. Crawford, London, Eng. General offices, Buena Vista Station, Mexico, Mex.

3. ***Mexican Central.***—Track laid in 1889, Salinas to San Jose, 117.8 miles, Tampico Division, end of track west 27.9 miles. Track laid since Jan. 1, 1890, San Jose to end of track, 86 miles. Surveyed, Guadalajara to 16 miles east of San Blas, 150 miles. President, Levi C. Wade, 70 Kilby St., Boston, Mass.

4. ***Mexican International.***—Projected, Sabinas to Tampagos, 70 miles, Jaral to Saltilo, 45 miles, Paila to Parras, 15 miles. General Manager, L. M. Johnson, Piedras Negras, Mex.

5. ***Mexican National.***—Vanegas, Cedral & Rio Verde R. R.—Track laid in 1889, Vanegas to Cedral, 18 miles. Under construction, Vanegas to Matehuala, 20 miles. Surveyed, Cedral towards Rio Verde, 58 miles. Projected, end of track to Rio Verde, 149 miles. Under construction, Maravatio to Colima, 250 miles. President, W. S. Raoul, 6 Wall St., New York City.

6. ***Mexican Pacific.***—Under construction, Tonala to Frontera, 400 miles. General office, 2 Tokenhouse Buildings, London, Eng. Chief Engineer, E. A. Warner, City of Mexico, Mex.

7. ***Mexican South rn.***—Under construction, Puebla to Tecumavaca, 139 miles. Projected, Tecumavaca to Oaxaca, 110 miles. Engineers, Jas. Levesey & Sons, London, Eng.

8. ***Michoacan & Pacific.***—Track laid since Jan. 1, 1890, Maravatio to Troye's Smelter, 31 miles. Superintendent, L. R. Gordon, Maravatio, Mex.

9. ***Monterey & Mexican Gulf.***—Track laid in 1889, Monterey to Linares, 147 miles. Track laid since Jan. 1, 1890, Monterey to Venaditto, 67 miles. Under construction, Linares to Tampico, 281 miles. President, Geronimo Trevino, Monterey, Mex.

10. ***Sonora, Sinaloa & Chihuahua.***—Under construction, Deming, N. Mex., to International boundary, 30 miles. Partly Graded, Guyamas east, 80 miles. Surveyed, International boundary south 120 miles, end of grade from Guyamas east 120 miles. Projected in States of Sonora and Chihuahua, 200 miles. President, Geo. H. Sisson, New York City; Loren Miller, Deming, N. Mex.

11. ***Tehuantepec.***—Under construction, between ends of track, 190 miles. Chief Engineer northern division, Sir Thos Tancred, Coatzacoalcos, Mex.; Chief Engineer southern division, Don José Velasquer, Tehuantepec, Mex.

11½. ***Yucatan.***—Under construction, Tekanto to Izamal, miles; Tixcocob to Sutula, 30 miles. Contractor, Jno. W. Glenn, New Orleans, La.

Projects and Surveys.

12. ***Catorce & Tula.***—Projected, Catorce to Lula, 97 miles.

13. ***Cuernavaca & Toluca.***—Projected, Cuernavaca to Toluca, 35 miles. Concessionnaire, Carlos Quaglia.

14. ***Durango & Northeastern.***—Projected, Durango to Mexican Central Ry., 55 miles.

15. ***Guadalajera & Chapala.***—Projected, Guadalajera to Chapula, 30 miles. Commissionaire, Pedro Landaguri.

16. ***Matamoras & Matehuala.***—Projected, Matamoras to Matehuala, 275 miles. President, General Pedro Martinez.

17. ***Mazatlan & Rosario.***—Projected, Mazatlan to Rosario, 30 miles. Concessionnaire, Alberto Sanchez.

19. ***Mexican Continental.***—Projected, Matamoras to Tehuantepec Ry, with branches to City of Mexico and Guatemala, 1,800 miles.

20. ***Mexican Western.***—Projected, Aguas Calientes to Chamela, 130 miles.

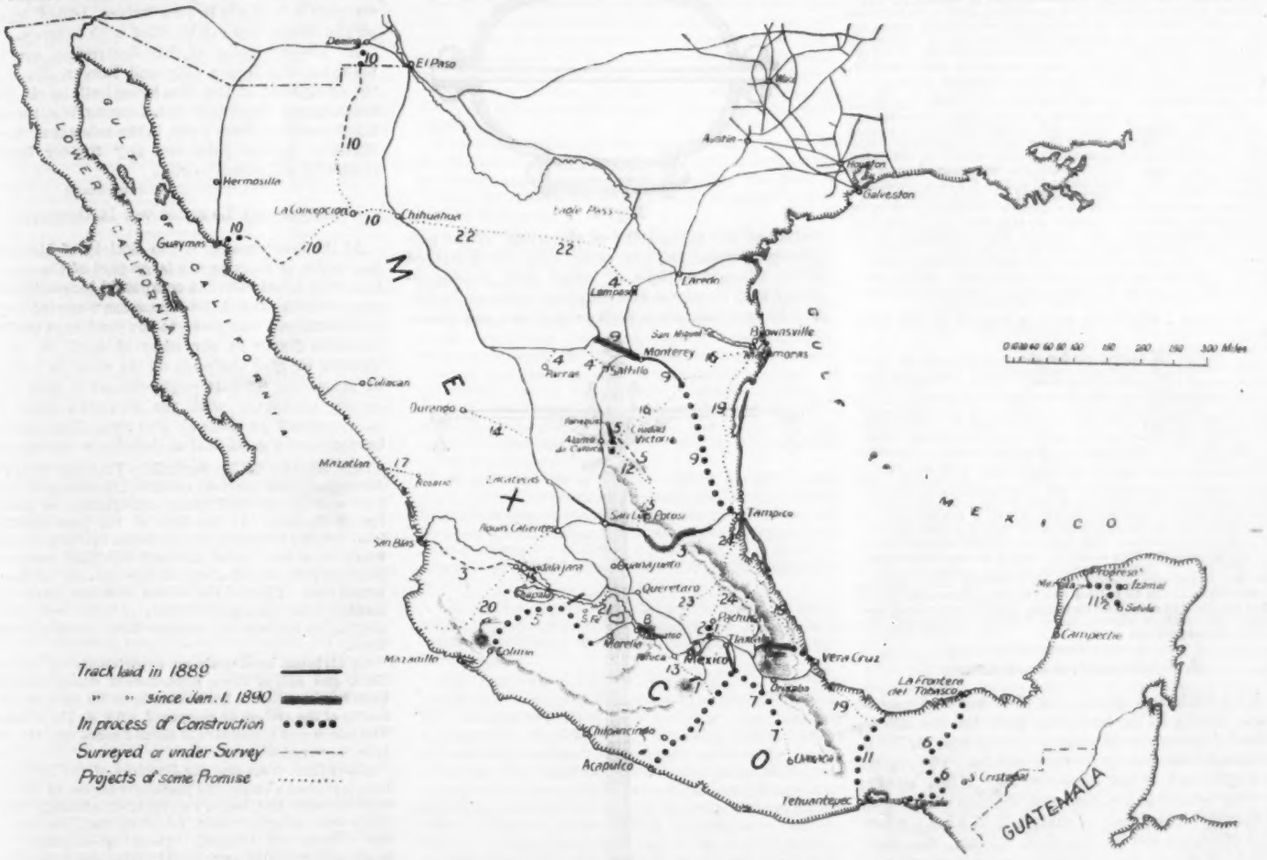
21. ***Salamanca & Ville de Santiago.***—Projected, Salamanca to Ville de Santiago, 20 miles. Concessionnaire, Josè Domaneck.

22. ***Sierra Majada & International.***—Projected, Sierra Majada to International Ry., 150 miles. Concessionaire, Enrique Baz.

23. ***Tula & Zacualtipan.***—Projected, Lula to Zucualtipan, 40 miles.

24. ***Zacualtipan.***—Projected, Pachuca to Tampico, 175 miles.

Total.—Track laid in 1889, 410.26 miles Track laid since Jan. 1, 1890, 214 miles. In process of construction, 1,025 miles. Surveyed or under survey, 448 miles Projects of some promise 3,649 miles.



Map Showing Progress of Railway Construction in Mexico

The Latest Phase of the Brooklyn Bridge Problem.

The Board of Trustees of the New York and Brooklyn Bridge, as represented by Mr. JAMES HOWELL, their President, have at last tacitly admitted that they cannot or dare not carry out the plan which has stood for two years as "adopted," and have sent up to Albany a bill providing, among other things, for the appointment of a new board of three experts, of which the Chief Engineer and Superintendent of the bridge is to be chairman, one other member being appointed by the Mayor of New York, and one by the Mayor of Brooklyn. By the original bill two out of three were to report. As since amended unanimous agreement is required. We forbear comments of our own, adding only certain opinions on their proposition expressed by the New York *Tribune*, *Sun* and *Times*.

The *Tribune* makes the following comments:

The record of the Brooklyn bridge management for the last five years has been anything but glorious in many respects. But perhaps as extraordinary and discreditable a proposal as has ever emanated from that body is that which President HOWELL has this week transmitted to Albany to be enacted into law. That is, in effect, an effort to pack a "Board of Experts," nominally to tell the trustees and their officers what to do next, but really to condone what they have not done in the past.

What are the facts? Four years ago the urgent need of enlarged transit facilities was first formally recognized. Nearly three years ago (May, 1887), the trustees thought they had found a way out of their troubles, and adopted it in a twenty-minute session. They had hardly adopted it when its folly was exposed, and it was incontinently dropped. They then appointed a board of three experts, who, two years ago (Feb. 23, 1888), gave them certain advice, after hearing all that could be urged in favor of seventeen different plans, about half of them submitted by their own engineers. The advice given did not suit. It condemned the plans emanating from the bridge authorities, and recommended another and very different plan. The trustees in another twenty-minute session reversed this action, rejecting what had been recommended, and "adopting" what had been in terms condemned, the plan of their chief engineer, Mr. C. C. MARTIN. It was then publicly alleged that the plan could not and would not work, and that they would never dare to put it in practice. Two years have passed, during which they have had full authority to put this plan into operation. They have not yet taken the first step toward doing so.

And yet Mr. HOWELL now coolly proposes, in the face of this record, that the man who was a disappointed competitor before the last Board of Experts shall be by law established in the chair of a new Board of Experts! The other two members of the Board are to be appointed by the Mayors of New York and Brooklyn, without a single stipulation as to their qualifications. Such a board could hardly fail to find that the trustees and their chief engineer had been from the beginning, were now, and ever would be about right in their views. The chance for any real improvement in the bridge facilities would be again indefinitely postponed.

Let us have no such trifling with a great problem. Let us have a real Board of Experts or none. If the trustees wish and dare to carry out the already adopted plan of their chief engineer, let them do it. They have full authority. If they fear to do this, and wish expert advice, let them seek it decently and in order, from men above suspicion of bias or incompetency.

The *Sun* comments as follows:

The effrontery of the proposition of the bridge trustees that their Superintendent, C. C. MARTIN, be made chairman of a Board of Experts to pass upon transportation plans has not been fully made manifest. The bridge problem has been passed upon by one board of experts whose competency nobody dares question. That board unanimously condemned the plans suggested by Mr. MARTIN, and approved another plan. The plan recommended by that board was rejected by the trustees on the ground of expense, after enormously exaggerated estimates of the cost of it had been submitted by Mr. MARTIN without the knowledge of the designer. The condemned plan of

Mr. MARTIN, slightly modified, was then adopted by the trustees. Now, this ingenuous board proposes that Mr. MARTIN shall be chairman of a board of three experts who shall pass upon his own plan and those of his rivals. It is analogous to making the unsuccessful plaintiff in a lawsuit the chief justice of the court which is to pass upon his own appeal. And what shall be said of a man who will allow himself to be placed in such a situation?

Mayor CHAPIN recognized the audacious impropriety of such a proposition, and endeavored partly to counteract it by asking the Senate Committee to require a unanimous, instead of a majority, report from the Board of Experts. But that does not by any means put the matter upon an impartial basis. What reputable engineer could could be induced to serve on a packed jury? Who ever heard of one of the participants in a competition having a seat on the judges' bench? A prominent engineer, who has designed one of the most highly indorsed plans ever suggested for bridge improvement, yesterday told a *Sun* reporter that he would not appear before a board constituted as the Jacobs bill provides.

Furthermore, no conditions whatever as to experience or competency on the part of the members of the proposed Board of Experts are made in the Jacobs bill. In fact, that feature of the measure is very loosely drawn. Why not make the Mayors of New York and Brooklyn and the President of the American Society of Civil Engineers, whoever he may be, the appointing board, and stipulate that the appointees shall be men of extended experience with transportation problems, and who have no personal interest in any proposition which may come before the Board? Such a tribunal would be an eminently impartial one, and it would have the advantage of all the information which the bridge engineers could supply, just as fully as if Mr. Martin were a member of it.

The more the secret history of the rejection of the recommendations of the Board of Experts in 1888 is inquired into, the more indefensible does the action of the bridge authorities appear. There seems also to be good reason for believing that nearly all the trustees were grossly misled in having forced upon them a plan which is ridiculed by practical engineers. The experts who passed upon the plans offered were these men: WALTER KATTÉ, Chief Engineer of the New York Central system; JULIUS W. ADAMS, ex-President of the American Society of Civil Engineers, and the builder of the Erie Railroad; and JOSEPH CRAWFORD, the General Superintendent of the New Jersey lines of the Pennsylvania system. These are all broad gauge, practical men of undoubted eminence in their profession, and they took a broad view of the problem set before them. Scheming and misrepresentation prevented the adoption of the plan recommended.

The New York *Times* says in regard to this question:

The Senate bill providing for the appointment of three engineering experts, whose decisions shall be binding upon the trustees of the Brooklyn Bridge, has one fatal defect. It provides that Superintendent MARTIN shall be one of the experts. Mr. MARTIN is not an expert in railroad operation. He has had no training in that branch of engineering except what he has gained at heavy cost to the public by his wretched experiments with the bridge cable railway. Moreover, he is committed to his own plan of organized manslaughter which he calls "tail switching," and he is on record as opposing the only intelligent, economical, rapid and safe method of running the bridge trains, the loop system proposed by Mr. A. M. WELLINGTON. It would be a gross blunder to give him any authority in bridge management. But any legislation which leaves the blockhead trustees in office would be equally faulty. The problem of passenger service on the bridge is one of serious magnitude already. It is growing more serious every day. It can be solved only by engineers who are at once competent and disinterested. Ignoramuses and real estate speculators should have nothing to do with the bridge management.

A Consolidation Locomotive.

A consolidation engine for the Denver, Texas & Fort Worth R. R. has been built by the Rhode Island Locomotive Works, of Providence, R. I. It is intended for heavy freight service. The engine has cylinders 20 ins. diameter and 24 ins. stroke; driving wheels 50 ins. diameter; driving wheel base, 15 ft.; total wheel base of engine, 22 ft. 6 ins.; wheel base of engine and tender, 49 ft. 9¼ ins. The total weight of the engine in working order is about 122,000 lbs.; weight on driving wheels, about 109,500 lbs.; on pony track, about 12,500 lbs. The weight of the tender is about 75,000 lbs. and its tank capacity is 4,200 galls. The boiler is of homogeneous steel $\frac{7}{16}$ in. thick, riveted with $\frac{1}{8}$ in. rivets, and is calked within and without. The waist is 62 ins. diameter at smoke-box end, made wagon top, with extension arch. The 240 tubes are of charcoal iron, 2 ins. outside diameter, and 13 ft. 8 ins. long. The fire box is of Otis steel, 108⅛ ins. by 33¼ ins. The crown is supported by radial stays 1 in. diameter. Cast iron rocking and dumping grates suitable to bituminous coal are used. The Rhode Island Locomotive Works balanced valve is used in the steam chest. Piston heads have cast-iron spring ring packing. Piston rods are of iron, and the Laird guide and crosshead are used. The driving wheel tires are of standard steel 3 ins. thick; the first and fourth pairs are flanged, and second and third pairs are 6½ ins. wide. Driving axle journals are 7½ by 8 ins. The rods are of hammered iron, the parallel rods being put up with solid ends. Sellers' injectors, placed right and left, feed the boiler. The two-wheel truck under the front end swings from a radius bar. The wheels are Paige, steel-tired, 30 ins. diameter. The engine is fitted with Westinghouse brake for tender and train. The engine is to to be shipped Chicago, where it will be tested on the Chicago, Milwaukee & St. Paul road between Chicago and St. Paul in connection with their large ten-wheel engines, a number of which were built at the Rhode Island Works. After that it will be placed on the Minneapolis, St. Paul & Sault Ste. Marie Ry., and there tested against some very large engines, and after these tests it will be put on the Chicago, St. Paul & Kansas City to run in opposition to some of the large mogul locomotives between St. Paul and Chicago. After these tests are over the engine will be sent to its destination.

The Milliken Patent Pole for Electric Street Railways.

The pole here illustrated is intended to do away with some of the current objections to the overhead

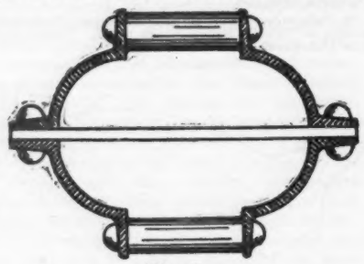


Fig. 1.

system of the application of electricity to the propulsion of street railway cars. This pole is formed of four Phœnix sections of rolled iron, riveted together with tie-plates and thimbles, as shown in Fig. 1. The arrangement is such as to give a pole graceful in form, light and durable, and yet having the greatest possible strength for the weight of material used. The pole is tapered in the direction of the pull from the weight of the wires, and the inside and the outside can both be painted, and thus indefinitely preserved.

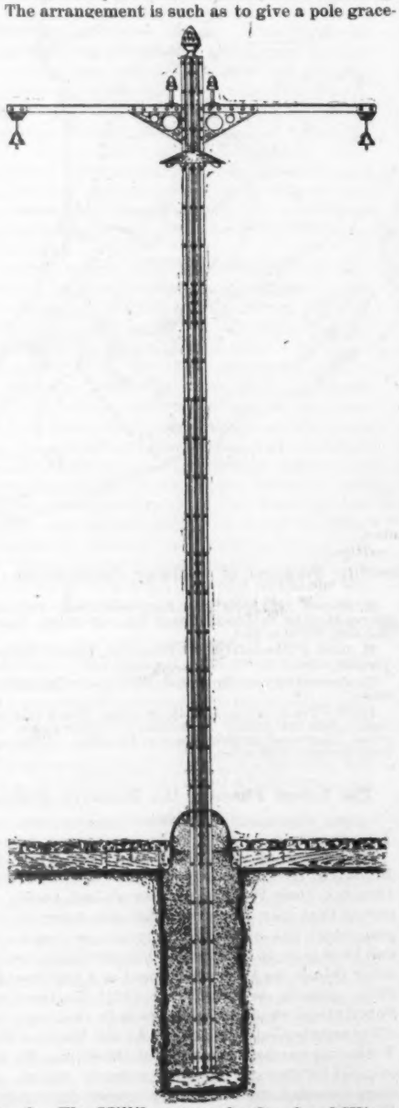


Fig. 2.—The Milliken Pole for Overhead Wires.

In a recent test of this pole at the Post & McCord Bridge Works, in Brooklyn, the pull at the top was measured by a Fairbanks dynamometer, and a strain of 800 lbs. thus applied produced a deflection of less than 4 ins. This deflection was in a regular curve, without the angles produced at the joints of a pipe-pole submitted to a similar test.

When used as a center pole between tracks, the longest diameter of the pole is, of course, set parallel with the track. The cross-arm is ornamental and strong, as shown in Fig. 2, and this can be made separate for shipping, if desired, and bolted in place. The cast-iron bumper, placed at the bottom of the pole to prevent wagon-wheels from striking it, is made in two halves, bolted together on the inside, and can be filled with concrete.

At present poles of this description are being made for the Jersey City and Bergen Ry. Co. for the equipment of the line being built by the Thomson-Houston Company. Mr. LEMUEL WM. SERRELL, 115 Broadway, New York, is the sole agent for this Milliken patent pole, and any further inquiries should be addressed to him.

Compound Locomotives in Germany.

At the last meeting of the Society of Mechanical Engineers of Germany, a large part of the proceedings was devoted to the compound locomotive. The paper which caused the discussion was read by Herr STAMBKE, and was given to the readers of the ENGINEERING NEWS in our issue of April 19. In this number we give abstracts of the views of a number of prominent German engineers, all of them prominently connected with the Prussian State Rys., as expressed in *Glaser's Annalen*. The discussion brought out a good deal of definite information.

Herr SCHREY (M. M. Berlin Div. Prussian State Rys.): According to the previous speaker, 118 compound locomotives were in use and 87 under construction on the State Ry. of Prussia. At the close of the year 1888-89, the total number of locomotives in use on that system of lines was 8,797; at the close of the year 1889-90 the number will be about 9,300; hence about 2.2 per cent. are on the compound plan. Five of the eleven divisions have experimented with compound engines of their own; one employing ten engines and another three in their investigations.

Six divisions have made no experiments on their own lines, and one of those departments where researches have been conducted has not rendered its decision of the merits of the system as compared with single expansion. The compound locomotive is about 5 years old, the usual type, however, about 50.

About three years ago the directors of the Berlin division borrowed a compound passenger engine of the Hanover division and began a series of experiments with it. These were so unfavorable, however, that, for the time, the subject was dropped. These investigations have lately been resumed on a much broader plan. But the unfavorable results of the first experiments show that the greatest disadvantage of the system lies in the fact that the management and care of the compound engine offer difficulties not to be overlooked, which would be particularly felt at a critical seasons, like a state of war, for instance.

The advantages of the compound engine are stated to be greater efficiency, greater economy of fuel and a decrease in the number of sparks thrown from the stack. The latter item can be attained much more cheaply in other ways, but as it is a present thrown in with the other things we should be duly thankful.

Experiments with a view to decreasing the fuel burned are as old as the locomotive itself; but the results were of negative value at the best, since economy was usually attained at the expense of simplicity of construction. Attention was first directed to the grate, and its form and the shape of the grate bars changed and rechanged; then the inner fire box was modified so as to obtain the best combustion, while experiments were conducted with a view of obtaining the proper form of the blast pipes and stacks. Great results were expected from each innovation, but, unfortunately never attained. Moreover, the exhaust steam has been used for several decades to warm the feed water. The appliances were all of a fairly simple nature, and the economy attained considerable; nevertheless, they have been gradually given up, since greater simplicity was considered necessary.

An economy in the use of fuel is, however, of secondary importance as compared with an increased efficiency, the chief superiority of the compound over the usual locomotive.

At first the efficiency was limited by the adhesion, until drivers were coupled. Gradually we have come to a condition of affairs where we regard the efficiency to be limited by the steaming power of the boiler. [This is strange doctrine; not true at all as respects American engines of any class.—ED.] Hence we are compelled to generate a greater amount of steam in the same boiler—which Herr STAMBKE declares impossible—or use the steam more economically. This latter is attained by using the compound engine.

Have the endeavors to use steam more advantageously failed? I believe we must answer Yes, although the modifications and improvements suggested have been very numerous. All these devices can be classed under one or the other of two heads:

a. Appliances to increase the effective work of the cylinders, and

b. Devices for diminishing the internal friction of the locomotive.

The latter class of improvements are of less importance than the first, since the lost work of the locomotive is always a small quantity. The improvements in the methods of lubrication, although important, have not influenced the efficiency to any appreciable degree. Most of the other inventions have given way, after a longer or shorter trial, to the old but simple appliances.

To this class of improvements belongs the Allen valve, which has many enemies still among the admirers of the old D valve. Unquestionably this valve diminishes the bad effects of the common valve gear, viz., slow opening and closing of the ports, and bad exhaust with a late cut-off; but any marked difference between the efficiency of a locomotive equipped with an Allen valve and a similar engine without does not exist.

A fact that speaks very highly for the compound locomotive is the greater range of expansion of the steam that can be attained in that system. The actual expansion in the simple locomotive is much less than is usually supposed. The expression "a cut-off of one-tenth," is often heard and means simply that the valve closes the ports after passing through a distance equal to one-tenth its travel. The real ratio of expansion, however, is not 1:10. At the beginning of the stroke, the clearance space, amounting to one-tenth of the cylinder volume, is filled with live steam. When the cut-off takes place, two-tenths of the volume of the cylinder is filled with steam, although the piston has made but a tenth of its stroke. Hence, since exhaust begins at six-tenths of the stroke, the actual expansion is expressed by the ratio 2:7 or 1:3.5

The compound locomotive, on the contrary, allows a much greater expansion to take place. About twelve years ago, the Berlin division took a large number of cards. A careful examination of these showed that indicator experiments on locomotives leave much to be desired. This is to be attributed to several causes, chiefly however, to the amount of water in the steam used.

Herr VON BORRIES: I consider the advantages of the compound locomotive numerous and great enough to warrant their universal use. The defects mentioned by Herr SCHREY, the greater cost and difficulty of the repairs, are overestimated or do not exist. Experience has shown, moreover, that whenever a number of compound engines are in use they outlast the simple type.

The management of engines with automatic starting apparatus does not differ from that of simple locomotives; even when this apparatus is out of order it can always be set in operation by a single blow.

It has always been stated that it has taken 50 years to bring the simple locomotive to its present condition, while the compound type is only about five years old, and up to the present time comparatively few engineers have studied it.

The present compound engines run with a cut-off of .35 to .4 in the high-pressure cylinder, and have cylinders in the ratio of 1 : 2. Hence the expansion is five or six-fold not much more than in the ordinary locomotive. The expansion in the compound engine should be much greater than it now is, but this is impossible under the methods of construction now in vogue, since the compression would be too great and the engine would run badly. The compression begins with the pressure in the receiver, about 3 or 4 atmospheres, and rises rapidly, necessitating special dimensions of the high-pressure cylinder in order that it may not rise too high.

In order to employ an earlier cut-off without increasing the compression, the pressure in the receiver must be so lowered that the cut-off in the low-pressure cylinder is delayed; the gearing could then be set farther back before the same compression occurs. Such a procedure, however, would destroy the equality existing between the work of the two cylinders. If the cylinder volumes are given another ratio than 1 : 2, for example, 1 : 2.25, then the pressure in the receiver will be diminished and the degree of expansion increased.

A second point is the maintenance of the fire, which in simple locomotives depends upon four jets of steam with each revolution of the drivers; in compound locomotives, however, on two during the same time. In the latter case there are two short pauses when no exhaust takes place, this being due to the position of the low-pressure valve, which then closes the exhaust ports.

Probably these pauses can be avoided by cutting steam-ways in the inside lap of the valve, which will cause the exhaust to begin at one end slightly before it ceases at the other. This plan has been described in the *Revue Generale des Chemins de Fer.* Experiments with this kind of a valve will be made soon in Hanover, both compound and simple locomotives being used.

The old defects of the compound locomotive have so far disappeared that they are of no significance now. The rapidity with which the valve of the high-pressure cylinder wore out has been diminished. This rapid wear not only caused a comparatively short life for the valve but also reduced the efficiency of that cylinder more or less by impeding the flow of steam from the boiler through the high-pressure cylinder to the receiver. The poor starting of an engine has often been ascribed to faulty starting gear when it was really caused by defective valves. Oftentimes, also, a jerk has been seen in the motion of the valve-rods; this had little effect on the running of the engine and was remedied by proper oiling.

The greater efficiency of the compound over the simple locomotive was proven by experiments made last autumn on the line between Hamburg and Hanover. At the place where the investigations were made the grade was 1:300. The trains were as heavily loaded as possible, consistent with running on time. At a speed of 60 kilos. (37.5 miles) an hour on the long up-grades, the compound engine delivered 600 actual H. P. to the train, while the simple engine furnished only 450, a ratio which shows that the compound locomotive is capable of a materially greater efficiency.

A compound locomotive has been placed in service on the Michigan Central Railway in North America; the dimensions and plan of the engine are about the same as with us, save that a bad design for the valve gear has not acted with success.

An interesting application of the compound system has been made by Herr KLOSE, in Stuttgart, who has designed an adhesion and rack-rail locomotive, in which the steam passes first to the cylinders of the adhesion engine and then goes to the cylinders driving the gear wheels. This distribution of parts is not only very simple but also works better than the usual method, since the steam works more evenly in the low-pressure cylinder. The two methods of propulsion balance each other in practice. If the drivers slip on the rail then a greater amount of steam enters the receiver and causes a back pressure that stops the irregular motion of the locomotive and also causes the gear to make up the loss in tractive force by working more powerfully.

The compound engine has been widely adopted during the last year. According to my estimate, on Nov. 1, 1888, 310 engines were in use or under construction, and a year later about 600. During the winter this number has been greatly increased. Many of these locomotives were for countries on other continents, notably the Argentine Republic.

I am of the opinion that the compounding of steam should be introduced into locomotives for usual service outside of switching, since their efficiency would be materially raised.

Herr LOCHNER could not agree with the previous speaker in his unfavorable opinion of indicator diagrams. It is certainly difficult to make indicator experiments on a locomotive, especially at high velocities; a great amount of practice is necessary before really useful cards can be obtained. Care must be specially directed to seeing that no water is in the cylinders, a condition easily attained by seeing that the pistons are well packed and the cylinders properly warmed before taking the diagrams. Experiments were made in the past year in the Erfurt division on compound and simple engines, as already mentioned. During these investigations Herr LEITZMANN took over 1,500 cards, which do not differ materially from those of a stationary locomotive, provided it were furnished with the link gear.

I gladly concur in the desire of Herr SCHREY that many comparative trials between the compound and single types be made, for in this way we will first be able to accurately locate and remedy the existing defects. For this purpose I venture to propose the following method of comparing the work of two locomotives.

In such investigations we are to distinguish two cases. The first when our object is to determine the steaming power, and the second when we wish to find the ratio of the efficiency of the locomotives and the steam consumption. We will consider the latter case in the following investigation:

Let d = the diameter of a cylinder (in meters).
h = the stroke (in meters).
D = the diameter of the drivers (in meters).
w = the weight of a cubic meter of steam at boiler pressure.
e = the ratio of cut-off to stroke (in per cent.).
v = the speed of the train in kilos. per hour; then the steam used can be calculated from the formula:

$$V = \frac{4\pi d^2}{4} \cdot \frac{c\,h\,v\,1{,}000\,w}{100\,\pi D} = 10\,\frac{d^2 h}{D}\,w\,e\,v,$$

or, if we let $\frac{d^2 h}{D}$ be denoted by a,

$$V = 10\,a\,w\,e\,v.$$

Then the amount of steam, S, used per unit of time and unit of actual power is

$$S = \frac{V}{N},$$

where N stands for the efficiency of the locomotive. If the corresponding values for a second engine are denoted by prime letters, then with equal speeds and loads, we have

$$\frac{S}{S'} = \frac{a\,w\,e}{a'\,w'\,e'}.$$

In making the tests, the same cars are to be run over the track by the two locomotives as quickly after each other as possible. The steam pressure and height of water should be kept constant, and readings taken every minute.

The time of the runs must be exactly the same, also, with the two locomotives.

This method has the advantage of omitting all difficult indicator manipulations, and still more troublesome direct measurements of the steam; all that is necessary is that one observer reads the steam pressure, height of the water and the speed of the train.

Herr VON BORRIES' statement of the faults of the compound locomotive is borne out by our investigations. That these engines do not work well with early cut-offs is well established in practice. During a trip on a compound engine belonging to the Magdeburg division, when an early cut-off would have satisfied the requirements of the case, the runner nevertheless set the gearing at two-fifths and half closed the throttle, a very unfavorable position of the engine for economical working. When asked why he did not reduce the cut-off, the driver answered that the locomotive would not work as well; that it never did so. This defect could probably be remedied by altering the ratio of the cylinder volumes. To the best of my knowledge, the locomotives in Saxony do not have our ratios of 1 : 2, but rather 1 : 2.4; possibly the correct value lies between the two.

Many faults have also been found with the exhaust and blast pipes in the Erfurt trials. Since the steam jets are less both in number and force in the compound than in the simple engine, it follows that the combustion is not so great in the first type of locomotives as in the second, and hence the steaming capacity of the first falls below that of the second. We could not generate so much steam in the compound engine as in the simple, even after the blast nozzles were given the most suitable dimensions. The same thing I have noticed on a compound locomotive in the Frankfurt passenger service; the efficiency was undoubtedly less than that of our new standard engine for the same service. How far this was due to bad fuel and lack of skill I am unable to state.

Our investigations show that the common valve gear is very unsuitable at high speeds, even with Allen valves. Experiments with a standard locomotive gave the following results:

If we place the effective work of a locomotive at 10 kilos. (6.25 miles) an hour as 100, then, with the same cut-off, the effective work at 30 kilos. (18.75 miles) is 90 per cent., at 50 kilos. (31.25 miles) 76 per cent., at 90 kilos. (56.25 miles) 55 per cent. of the original amount.

This decrease is, it appears, dependent only on the velocity, not on the cut-off, and must work very injuriously in the compound locomotive by reducing the initial pressure in the high-pressure cylinder. A greater amount of attention should be spent on the valve gear, and I am firmly convinced that improvements in this direction would result in an extraordinary increase in the economical working, efficiency and steam consumption of the compound locomotive.

Herr TILLY said that, out of the 118 compound engines on the Prussian lines, 27 are on the Paderborn section, which also possesses 35 standard locomotives, and there are consequently many opportunities for comparing the work of the two systems.

After the compound locomotives had been tried with good results in both express and local passenger service for about a year, they were exclusively adopted for express trains about June 1, 1889. These trains have an average speed of 75 kilos. (46.875 miles), running up to 178 kilos. (112 miles) in a trip, or in the neighborhood of 6,000 kilos. (3,750 miles) in a month.

The exclusive employment of compound locomotives was ordered, because on grades of 1:100 or more with 20 axles in the train, or on grades of 1:200 with a load of more than 25 or 26 axles, an assistant engine was necessary when simple locomotives were used, while a compound engine would pull from 23 to 25 axles on the first grade and 34 to 36 on the second without assistance. Since the length of trains rarely exceeds the last figure, the use of assistant engines was obviated by employing the compound system.

Recently some trials were made in this express service with two new standard locomotives, working with 180 lbs. boiler pressure. With short trains of 20 to 26 axles, and a cut-off of 1-5, these engines did as good service as the compound type. With greater speeds and a later cut-off, however, there was hardly any increase in efficiency, while the engine ran badly, with a large consumption of coal and many sparks from the stack. If these engines

were used, assistant engines would have to be reintroduced.

On the Soest-Northeim line an opportunity was afforded to compare the two types of locomotives as used in the freight service. From 22 to 27 coal trains run over this line per day, each train consisting of from 95 to 100 axles, the load per axle averaging 4.4 tons. Old freight, standard and compound engines were used in nearly equal numbers to haul these trains, the first type being given 90 axles, the second 110 axles and the third 115 axles. The tractive power of the locomotives was so nearly exhausted by these loads that small differences in their efficiency were easily discerned.

Many observations showed that the tractive power amounted to:

	On a grade 1:100 with a speed of 14-15 kilometers (8.75 to 9.375 miles). Pairs of wheels.	On a nearly level track at speeds of 25-30 kilometers. (15.625 to 18.75 miles). Pairs of wheels.
With compound locomotives...	50 to 55	110 to 120
With standard locomotives...	50 to 55	105 to 110

On the 1 per cent. grades the tractive power of both engines was limited by the adhesion of the driving wheels to the rails, while on the nearly level stretches it was found that the tractive force of the standard locomotive was limited more by the steaming power of the boiler that of the compound locomotive more by the adhesion of the engine to the rails.

The form and position of the blast pipes are of more importance in the compound than in the simple engine. All bends should be avoided in order that the steam in its passage need not be impeded. The best results are always attained when the cone of escaping steam fills the smoke-stack about a foot and a half below its upper extremity. In compound freight engines the diameter of the blast pipe should be from 5.3 to 5.5 ins., in similar passenger locomotives about 4.84 ins.

I cannot make any more accurate statements as to the consumption of coal than those already offered. In consequence of the saving of 18 per cent. attained by compound locomotives, the allowable coal consumption was diminished by 5 per cent. Under these conditions, however, the engineers were paid more premiums for economy in management than those running standard engines.

I believe that the cost of repairs for a compound locomotive is less than that for similar work on a simple engine—certainly not more. A basis for such a comparison can be found by examining the efficiency of a number of locomotives between the beginning of their service and the first complete overhauling. [We omit a long detailed statement.]

It is seen from this statement that two compound freight locomotives built in 1887 have been less efficient, the other compound locomotives more efficient, than the corresponding simple engines. The less efficiency in the first case was due to bad lubrication and imperfections in the valve gear, which were soon remedied. The present valve gear has worked admirably.

In three of the engines, the valves of the high-pressure cylinders broke and had to be renewed, and minor repairs were necessary to the valves of five more. The trouble was always caused by an uneven lubrication of the wearing faces. I believe that compound engines should be generally adopted.

The maintainance and care of the compound locomotives at present are such matters of pride to the men that they are kept in much better condition than the standard engines. It is only natural that, while the number of compound locomotives remain so small, they should be entrusted to the most skillful men. I believe that if the other locomotives were as well handled the results would be equally as good. My remarks about the difficulty of handling the engines were not well understood, apparently. I maintain that any railway machinist could repair a simple locomotive, even if the valves were removed; but this could not be done with a compound engine, if the starting apparatus or valves were destroyed.

Cable Traction Efficiency Diagram.

The accompanying diagram, showing the power required to operate street cars by the cable method is deduced from careful observations on one of the lines of the Metropolitan Street Ry. Co. of Kansas City, Mo.

The coal consumption given is not absolutely correct, it being only as close an approximation as could be obtained without precise weighing of that used on the day the cards were taken. The cost per passenger is, of course, based on this approximation.

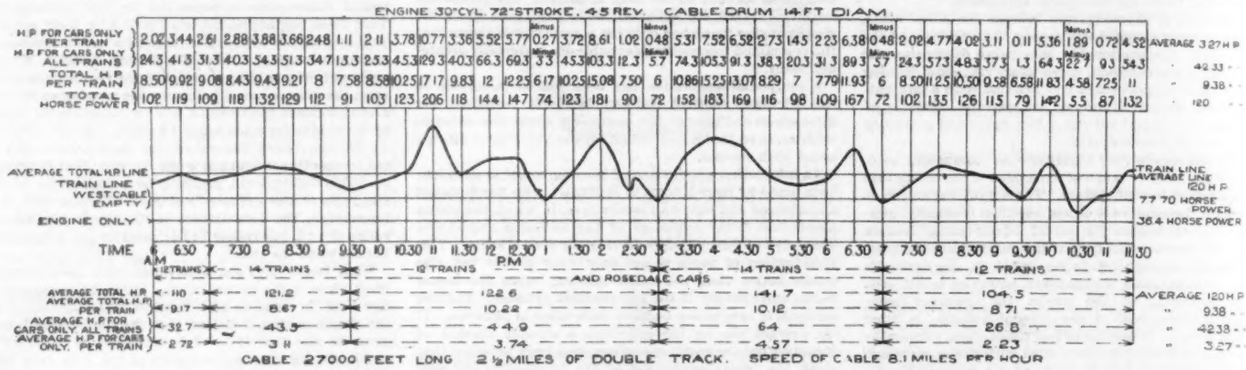
Trains on this line, ordinarily, are composed of but two cars, but to many of them a third car is connected at a certain point, and carried over a portion of the line. This is what is meant by "Condensed number of passengers on exclusive one line basis," the figures given being for one line after eliminating these extra cars. At the time of the trial the line had not been long in operation by cable, and though the road was designed to have, and is now being operated by, two cables only, the one for the Western portion had not then been put in operation. The traffic has since greatly increased.

The diagram was made by Mr. FRANK ALLEN, while in the employ of the company, and to his courtesy we are indebted for a copy of it.

The diagram illustrates again, what is now well understood, the enormous loss of power involved in merely pulling the cable around, making the cable very uneconomical for a light, irregular traffic. For a heavy traffic, on the contrary, it is not yet shown that any other motor can compete successfully with the cable.

The H. P. necessary to move the engine only was found to be 36.4 H. P.; for the cable only, at 8.1 miles per hour, 41.3 H. P. more, or 77.7 H. P. in all, the cable being over five miles long. On the other hand, the H. P. per two car train was only 3.27 H. P. as an average of the whole day, or 42.38 H. P. in all, added for the cars, which averaged 13 trains of two cars each.

There are certain inconsistencies in the figures which it is difficult to explain, as will be discovered on examining the diagram in detail; but as a whole the diagram is fairly conclusive that on a line of this character and traffic two-thirds of the power goes in simply moving the cable and machinery, and only one-third in propelling cars.


ENGINE 30" CYL. 72" STROKE, 45 REV. CABLE DRUM 14 FT DIAM.
H.P FOR CARS ONLY PER TRAIN
H.P FOR CARS ONLY ALL TRAINS
TOTAL H.P PER TRAIN
TOTAL HORSE POWER
AVERAGE 3.27 H.P
AVERAGE TOTAL H.P LINE
TRAIN LINE WEST CABLE EMPTY
ENGINE ONLY
TRAIN LINE AVERAGE LINE 120 H.P
77.70 HORSE POWER
36.4 HORSE POWER
TIME
AM
PM
12 TRAINS
14 TRAINS
AND ROSEDALE CARS
AVERAGE TOTAL H.P
AVERAGE TOTAL H.P PER TRAIN
AVERAGE H.P FOR CARS ONLY ALL TRAINS
AVERAGE H.P FOR CARS ONLY PER TRAIN
CABLE 27000 FEET LONG 2½ MILES OF DOUBLE TRACK. SPEED OF CABLE 8.1 MILES PER HOUR

Cable Traction Efficiency Diagram. Metropolitan Street Ry., Kansas City, Mo.

The Austro-Hungarian Zone System of Railway Fares.

Starting from any station in Hungary, you may now travel to the first or second station for a uniform price, 10 or 15 kreutzers for the third class. These comprise the "local zone." The "first zone" includes all stations within 25 kilometres. Here the price for the third class is 25 kreutzers. The zones extend by steps of 15 and 25 kilometres up to 225 kilometres. All distances beyond this are in the "fourteenth zone." The fares increase from the first zone to the twelfth for the third class by 25 kreutzers, then by 50 kreutzers. Thus the highest price that can be paid for an ordinary third-class ticket in Hungary is four gulden, about $1.60. Second-class prices are 50 or 60 per cent. more. First-class prices are double the third. Twenty per cent. is added for express trains. The average reduction in fares is about 40 per cent. Similar arrangements are made for freight, but here the reduction is immaterial. On long distances the difference in fares is enormous. A ticket from Buda-Pesth to Kronstadt, in Siebenburgen, that used to cost over 23 gulden, can now be had for 4 gulden. The financial result of this radical reduction, so far as official figures are at hand, is as surprising as it is gratifying. The number of passengers has about doubled; the net receipts have increased 8 per cent. The Government is so well satisfied with the result that it is already planning still further to simplify the system and reduce the number of zones.—*Evening Post.*

Rolling Steel Rails.*

In a three-high mill a rail is made at one heat, and generally in eleven passes, from a bloom 7 ins. square, or a little larger.

The first six passes are taken up in working the bloom from side to side into a billet, rudely, the shape of a rail It is then ready for the finishing rolls. The seventh pass, or squabber, which is generally the first pass in the finishing train, is principally for forming the flanges of the rail (Fig 1). The billet goes through this pass with the head down and the flanges horizontal; the flanges are caught between the two rolls, and made thinner and wider according to the distance between the rolls forming the pass, so that this pass has almost absolute control of the flanges. The rail passes through the three succeeding passes with head and flanges vertical, without any change except uniform reduction and a gradual increase in the height. Then the rail goes through the finishing pass, where the head is rounded (Fig. 2), and from that it passes on to the saws to be cut.

Assuming that the passes have been properly turned out, it is the essential feature of the whole matter of rolling a rail to have them all exactly filled. If the bar does not fill out to any pass, more stuff is put in the pass; this is done by enlarging the preceding pass or passes by moving the rolls apart so as to bring out a bar of larger cross section. On the other hand, if the bar is of too great a cross section for the pass to roll out in length, the extra metal will squeeze out in the partings of the rolls, and either sheer off or make a fin. The opposite course of treatment must then be resorted to.

Side-guards are used to guide the bar to the pass, and to aid in keeping it from twisting or drawing to one side on leaving the pass. Side-guards are sometimes called into play to put more metal into one side or the other of a piece by forcing it over, and compelling one side of the pass to rob the other. It is unnecessary to have a side guard on each side of the pass when there is a greater amount of draught on one side of the bloom than on the other. The extra amount of draught on the one side throws the piece to the opposite side. There is then no need for a side-guard on the side the bar has no tendency to touch.

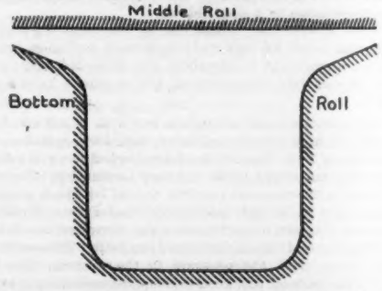


Fig. 1.—Squabber Pass for 60-lb. Rail.

The purpose of a guide is to keep the bar from following the roll on coming out of the pass, when for any reason it has a tendency to do so. The pass in the rolls is turned out so as to throw the piece against the guide to insure the bar being delivered safely from the rolls. Guides and side-guards are then exactly as their names indicate, to

*A paper by D. K. NICHOLSON, Steelton, Pa., read before the New York meeting of the American Society of Mechanical Engineers.

"guide and guard" the bar in entering and leaving a pass in the rolls.

Finning and shearing comes from the metal squeezing between the partings of the rolls. It is the result, as stated above, of too much stuff going in the pass or part of the pass, or the bar not properly entering the pass. A small fin, or the indication of one, is the only positive evidence there is that the bar has filled out as intended. The wedge-like shape of the flange of a rail gives a considerable amount of end thrust to the rolls. If this thrusting is not met by a force sufficient to overcome it, the rail will be higher on one side than the other, and have a thick and and thin flange (Fig. 3).

Of all the troubles to be overcome in rolling a rail, the overfilling of the head in the finishing pass is probably the greatest. There is no real remedy for it except re-turning the rolls. Since the head of the rail is made somewhat rounding, the two rolls must be parted at the middle of the head in the finishing pass. When the metal runs out between the collars, it makes a fin, which is generally objected to more on account of its appearance than the harm it does (Fig. 4). The cause may be looked for in the pass immediately preceding the finishing, the leading pass. When the rail has too much stuff under its head on each side of the web on coming out of this pass, on entering the finishing there is nothing to oppose this side work at the middle of the head where there is a space ¼ in. wide between the collars of the rolls. From this it is plain that the greater the angle under the head of the rail the more scope for the roll turner in the leading pass, and consequently the less liability to fin or overfill in the finishing pass. Rounding the collars with a file will sometimes make the overfilling less noticeable.

Fig. 2.

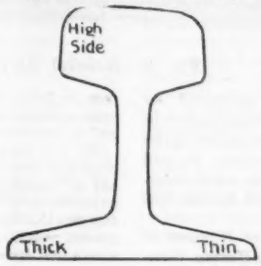


Fig. 3.

Fig. 4.

In speaking on the subject of the amount of draught that ought to be put on a piece of steel, no fixed rule can be given on account of the varying conditions under which a piece is rolled. However, taking nearly everything into account, 10 to 20 per cent. has been found to cover nearly all cases, when the piece is turned to receive work on all its sides. In breaking down a piece of steel, light draught tends to make the sides concave; the work seems to be confined near the surfaces on which it is being rolled. Heavy draught will have the opposite effect. It follows, as would naturally be supposed, that in the same rolls the hotter the piece the more the tendency of the stuff to go out in the length; while the colder and harder the piece the more spread, and consequently the more the tendency to fin. More spread may then be looked for in high carbon steel than in low carbon or mild steel. It might be here remarked that in either case the shape into which the piece is to be rolled has a good deal to do with an imperfection in the steel working out. For instance, a bad place in the part of the bloom falling to the head will work out, where it will not in the flange of a rail.

When a train of rolls is not strong enough, recourse can be had to three ways of making the rolls stronger: enlarging the diameter, shortening the body, and using better material in making the rolls. For every size bar there is a roll of a certain diameter that will make that bar probably better than a roll of any other diameter. Of course such a thing as having different size rolls for every section of rails would not be practicable. So a train is selected with respect to the average work that is to be done. Rolls of small diameter are more likely to work the flaws out of a piece of steel than rolls of a large diameter. There is very little spring in a roll with a short body. For these reasons alone it appears that the second of the above-mentioned schemes (to shorten the body) would be the one to adopt.

The great drawback to a cast-steel roll is the fact that the surface cracks so badly. They do very well for roughing or where enough passes follow to smooth the bar. A forged steel roll cracks very much less than a cast roll, but the cost puts it out of the question. As for strength, they may be said to be everlasting. This puts somewhat of a limit on the material used for a finishing roll after going outside of the best mixture of cast iron.

In a three-high mill the passes in the top and middle rolls can be altered without disturbing the passes in the middle and bottom rolls. A two-high mill has the advantage in handling the bar, since it enters all the passes of the rolls on the same plane; and it is only necessary to have two rolls instead of three. But then, in altering a pass, shifting one roll affects all the passes except where the finishing pass is in separate housings, which is a good thing in either train. The great speed at which the rolls are run after the bar has entered the pass in a two-high reversing mill often goes against the proper formation of the rail.

In going above two lengths it is very necessary to take every precaution in putting down a mill. The long-continued strain in a set of rolls when 120 ft. of rail go through is trying in the extreme on the rolls, especially as regards the end thrust.

Statistics of Railway Employes.

Mr. CARROLL D. WRIGHT, Commissioner of Labor, has submitted to the President, for transmission to Congress, his fifth annual report, in which the single subject treated is railway labor. This report shows that on June 30, 1889, the whole number of railroad corporations in the United States was, approximately, 1,718, and the mileage of these roads, approximately, 156,400 miles. The number of persons employed on all the railroads of the country on that date was 689,726—the trainmen numbering 135,580; switchmen, flagmen and watchmen, 31,896, and other employés, 522,250. For the purpose of investigation, the railroads of the country were divided into seven geographical groups, in which the general conditions of labor were of a like character. Sixty railways were selected, representing all parts of the country. Connected with the 60 roads under investigation, in these several groups, there were 241,910 employés.

Upon investigating the subject of the relations of employés and corporations, which was extended to about 600 corporations; by which the real railway business of the country is performed, it was found that 377 companies prohibit the use of intoxicating liquors. The rest either have no rules relating to the subject or have modified restrictions.

Nineteen roads maintain beneficiary institutions and some pay hospital expenses. A fair share of the roads assist their employés in securing life or accident insurance. Six companies pension their superannuated employés and also their permanently disabled people. The large number of 266 companies retain in their service permanently disabled employés, the number of such on the rolls at the close of the year 1888 being 3,121. Many roads also provide some sytem of technical education for men in their shops.

The wages side of railroad labor is given fully in the report. The whole number of specific titles of occupations of the 60 roads investigated is 1,117. For purposes of treatment in this report, these are classified into 17 occupations. The report shows the facts outlined for 241,910 employés. Of this number, 224,570 are employed on specified time, as by the day or by the month. Of the 224,570 employés involved, 56,404, or over 25 per cent., are employed 25 days or less out of the whole year; 31,024, or nearly 19 per cent., are employed from 51 to 100 days; 42,719, or 19 per cent., from 301 to 365 days; and 5,557, or 2.2 per cent., work more than a full year.

As to wages, it is found that over 73 per cent. are paid at rates ranging from $1 to $2 per day. The average daily rate of all the employés paid by specific time on the 60 roads is $1.64. Of the whole number of employés, 101,905 earn less than $100 per year; 53,621 earn from $101 to $200 per year, and 21,517 earn from $201 to $300 per year. The average earnings of all the 60 roads per year is $243, although less than 60 per cent. of all earn less than this average.

The report shows the average daily rate of pay in each of the seven groups of seventeen occupations. The average for baggage masters, for instance, is $1.63; brakemen, $1.78; locomotive engineers, $3.22;

Elements of Weather in the United States, of Most Interest to Engineers, for the Month of March, 1890.

[Furnished to ENGINEERING NEWS by Chief Signal Officer, U. S. A.]

STATION.	Temperature. (Deg. Fah.)				Wind.			Precipitation.—Rain and melted snow. Inches.		
					Velocity in miles per hour.					
	Average.	Max.	Min.	Range.	Average.	Maxim.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.										
Northfield, Vt	25.0	50	—13	72	9.3	36	S	2.54	.72	16
Portland, Me	30.7	51	5	46	8.0	31	S	6.24	1.18	19
New York City	37.5	71	6	65	11.9	38	SW	6.67	1.29	20
Pittsburg, Pa	35.8	68	5	63	6.2	35	NW	3.86	0.82	22
Chicago, Ill	29.5	56	0	56	18.6	68	NE	2.10	0.60	15
Omaha, Neb	32.6	65	1	64	10.4	44	NW	1.35	0.72	10
St. Paul, Minn	22.4	51	—16	67	7.8	34	W	1.11	0.32	13
Duluth, Minn	21.6	52	—11	63	7.6	37	NW	1.16	0 58	9
Bismarck, N. Dak	20.6	52	—24	76	11.5	54	NW	0.19	0.35	7
Average	34.0	58.3	—5.2	63.5	10.1	41.9	.....	2.84	0.73	14.6
SOUTHERN CITIES.										
Washington City	41.0	77	13	64	9.0	44	W	3.65	0 72	18
Louisville, Ky	41.2	67	13	54	8.0	42	W	9.58	2.51	15
St. Louis, Mo	39.0	69	6	63	12 4	60	W	5.99	2.31	12
Savannah, Ga	56.6	81	26	55	8.6	34	NW	2.75	1.65	13
Leavenworth, Kan	37.5	76	0	76	6.0	36	NW	1.00	0.28	8
Jacksonville, Fla	60.2	85	27	58	8.0	37	SW	2.89	0.76	10
Chattanooga, Tenn	48.8	76	15	61	6.6	34	SW	4.78	0.96	13
New Orleans, La	61.6	80	30	50	10.1	36	SE	1.45	0.90	7
Memphis, Tenn	49.2	81	17	64	9.6	48	SW	7.03	2.42	13
Palestine, Tex	59.0	87	29	67	9.5	30	NW	4.94	1.34	10
Average	49.4	77.9	16.7	61.2	8.8	40.1	.....	4.50	1 28	11.9
WESTERN CITIES.										
Helena, Mont	35.3	59	4	55	7.6	36	*	0.96	0.58	8
Port Angeles, Wash	†	†	†	†	†	†	†	†	†	†
San Francisco, Cal	53.8	70	41	29	7.5	26	NW	4.73	1.86	15
Salt Lake City, Utah	39.5	64	0	64	5.7	36	NW	1.12	0.42	11
Denver, Col	41.2	71	5	66	8.2	36	‡	0.35	0.26	4
Yuma, Ariz	65.0	90	44	46	7.4	46	W	§	§	0
Santa Fé, N. Mex	42.0	62	9	53	9.2	38	SW	0.69	0.48	7
Average	46.1	69.3	17.2	52.1	7.6	36.3	.....	1.31	0.60	7.5

* W and NW. † Report not yet received. ‡ N and NW. § Trace.

telegraph operators, $1.43; conductors, $2.77. A comparative table is given as to the wages paid railroad men in this country and in Great Britain. This table shows that the average daily pay of *locomotive engineers* in Great Britain is $1.46; in the United States, $3.22; of *firemen*, in Great Britain, 91 cts., in the United States, $1.79; conductors, 97 cts; *switchmen*, in Great Britain, 85 cts.; in the United States, $1.50; *flagmen*, in Great Britain, 81 cts.; in the United States, $1.13. The report further shows that 224,570 individual men were employed on an average 147 days each; and they received $243 average actual earnings for the year employed. These 224,570 men were employed to fill 105,807 places.

River Improvements at Cosel.

The *Centralblatt der Bauverwaltung* of Dec. 11 1889, shows that some extensive river improvements have been made recently at Cosel, a little town on the upper Oder. In 1780 a dam was built across the

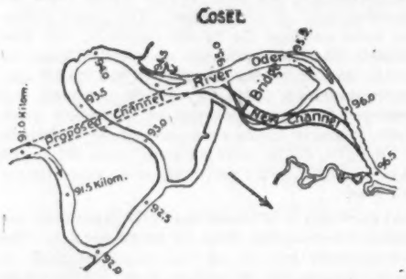


Fig. 1.—Plan of Oder River Improvements at Cosel.

river for the purpose of turning part of its water into the moats of the fortress on the right bank. In the spring time the flood was carried off through a small channel, shown just to the right of the word Oder, on the map. In 1873 the fortress of Cosel was abandoned. In 1884–85 a new bridge was built over the river at a cost of about $66,300. In 1886–87 a

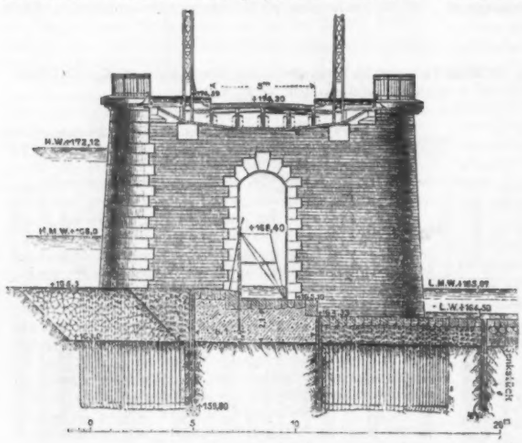


Fig. 2—Section of Bridge and Dam.

stone dam, costing $62,500, was built across the same.

The largest and most important wo rk was the cut ting and bridging of the new flood channel, marked Neuer Fluth Canal in the plan, Fig. 1. The bridge is provided with a needle dam, of which sections are shown at *B* and in the section of the bridge, Fig. 2. The new channel has a much larger section than the old, and is wide and deep enough to carry off the greatest volume of water that has ever been known at the place. The principal dimensions of the bridge and dam are given in the sketches, Fig. 3. The trusses are of the Schwedler type, so common in that part of Europe. The foundations are of beton, laid between rows of sheet piling. The piers are of limestone; the sills for the needles, the up stream starling, cornices and parapets are of granite, and blocks of the same stone line the floor of the dam. The pier on the left shore has a large chamber within, through which access is had to the bridge over the needle trestles.

This bridge is 0.4 m. above high-water mark. The trestles are of the best wrought iron. The needles are 3.5 metres long and are operated much as at the Seine dam at Port à l'Anglais. At the upper end of each is a hook which fits over the round bar against which the pieces rest. When the needles are raised so that their bottoms are free from the sill, the pressure of the water forces them into the inclined position shown in the sketch Fig. 4. They remain hanging in this way until the attendants unhook them. They are stowed away in the chamber in the left shore pier.

This bridge is at the point indicated on the map by a heavy black line. Above this place the canal has a width at its bed of 81 meters; below, the width is only 63 metres. It is nearly finished. The sides have a rise of 1 in 3. Some distance below the bridge they are protected by mattresses and riprap, and have a berm as shown in the section Fig. 5. Two-thirds of the centre of the excavation, containing about 100,000 cu. m., is said to have been made by the water in the canal alone. It is expected that the floods of next spring will complete the work.

The engineer of the works was Herr Roeder, of Ratibon. The resident engineers were Herren Wegener, Lieckfeldt and Nakong.

It is probable that a cut will be made soon, beginning near the 91 km. station in the Oder and ending a short a short distance below the 94.5 km. station. The position of this channel is marked on the map, "proposed channel."

Chicago's Progress.

Chicago, as it is, has now a national interest, and Mayor Cregier, in his annual message, enables us to pick out the following interesting items regarding its progress and present condition: By the act of June 28, 1889, taking in Lake View, Hyde Park, Lake, Jefferson and Cicero, 128.24 sq. miles of territory was added to the previous 44 sq. miles of old Chicago, and about 220,000 people added to the 850,000 of the former city. The present area is thus 172.24 sq. miles, and the population over 1,000,000. The bonded debt of the city on Jan. 1 was $12,561,500, and the balance in the treasury was $1,749,614.

In 1871 the "great fire" destroyed property to the estimated value of $200,000,000. Less than 8 months thereafter the assessed value of property left was $284,000,000. Assuming the assessed value of the destroyed property at one-third, and thus adding $66,000,000, the total assessed value in 1871, prior to the fire, was $350,000,000. Between 1871 and 1877, new buildings to the value of $50,000,000 were erected and between 1877 and 1890 the records show 45,000 new buildings estimated as costing $208,000,000. This is a total of $258,000,000 added since 1871, or, on the one-third valuation, $86,000,000 of assessable property since 1871. This does, not, of course, include the increase in the value of personal property. The total tax and license revenue in 1889 was $6,373,000, or $5.31 per capita of population, and about $37,000 per square mile of territory. The tax rate and total revenue in 1873 was equivalent to $16 per capita.

Chicago has grown from 2.55 sq. miles in 1835 to 172.24 sq. miles in 1889, though there are 5.14 sq. miles of water in the present area. During 1889, 116 lin. miles of streets have been improved, and 155,000 sq. yds. of pavements repaired in addition; 191 miles of sidewalks were laid and 89 miles of pipe added to the water system.

The marine commerce of Chicago amounted to 9,000,000 tons last year, and 20,000 arrivals and departures of vessels were reported. While the mortality rate compares favorably with other large cities, the questions of an increased water supply, drainage, garbage removal and the smoke nuisance are vital and require immediate attention.

Fig. 3.—General Elevation of Bridge.

The Iowa Safety Appliances Law.

The following is the full text (unimportant legal verbiage excepted) of the new Iowa safety appliances law:

AN ACT requiring all railroads, corporations, companies and persons operating a railroad and doing business in Iowa to equip all their engines and cars with proper, efficient and safe automatic couplers and brakes, and for prescribing penalties for failure thereof.

Sec. 1. It shall be unlawful for any corporation, company or person operating any line of railroad in this State, any car manufacturers or transportation company using or leasing cars, to put in use in this State any new cars, or any cars that have been sent into the shop or shops for general repairs, or whose draft rigging has to be repaired with a new drawbar or bars, that are not equipped with safety or automatic couplers or drawbars, such as will not necessitate the going between the ends of the cars to couple or uncouple them, but operated from the side of the car.

Sec. 2. After Jan. 1, 1895, it shall be unlawful for any corporation or any transportation company using or leasing cars of any description and used in the commerce of the country, or in the construction of railroads, to have upon any railroad in Iowa for use in the transportation of freight or passengers any car that is not equipped with such safety automatic coupler as provided for in Section 1 of this Act.

Sec. 3. It shall be unlawful for any corporation to use any locomotive engine upon any railroad or yard in this State after Jan. 1, 1892, that is not equipped with a proper

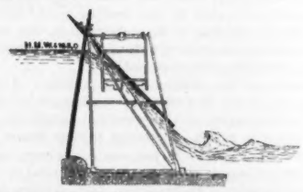


Fig. 4.—Section of Needle Dam.

and efficient power brake, commonly called a "driver brake."

Sec. 4. It shall be unlawful for any corporation to run any train of cars after Jan. 1, 1893, that shall not have in that train a sufficient number of cars with some kind of efficient automatic or power brakes, so that the engineer upon the locomotive car can control the train without requiring brakemen to go between the ends or on the top of the cars to use, as now, the common hand brake.

Sec. 5. Every railroad corporation operating a railroad in this State, and every person or persons using or leasing cars in the transportation business, or in building railroads, shall, and are, by this act, required to include in their annual report to the State railroad commissioners the number of locomotives, engines and cars used in this State, and what number is equipped with automatic safety couplers, and the kind of brakes and couplers used, and the number of each kind, when more than one kind is used.

Sec. 6. Any corporation using a locomotive engine or running a train of cars, or using any freight, way, or other ar contrary to the provisions of this act, shall be deemed guilty of a misdemeanor, and shall be subject to a fine of not less than $500, or not more than $1,000, for the benefit of the school fund, for each and every offense; provided, the penalties on this section shall not apply to companies in hauling cars belonging to railroads other than those of this State which are engaged in interstate traffic, and any railroad employé who may be injured by the running of such engine or train or car, contrary to the provisions of this law, shall not be considered as waiving his right to recover damages by continuing in the employ of such corporation, company, or person running such engine, or trains, or cars contrary to this law.

Approved April 5, 1890.

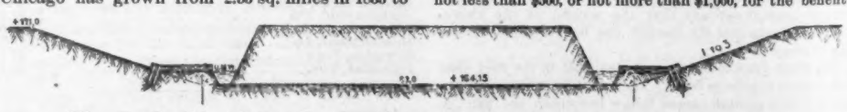


Fig. 5.—Section of Canal. Showing Part Left to be Excavated by Floods.

PERSONALS.

MR. P. J. FLYNN has been appointed General Manager of the Colorado Midland R. R.

MR. THOMAS B. BURNETT, Superintendent of the Peoria & Pekin R. R. has resigned.

MR. CALEB L. SMITH, architect, died in Brooklyn, N. Y., last week.

MR. WM. M. THOMAS, Vice-President of the Brooklyn City R. R. Co., died in Brooklyn, N. Y., April 24.

MR. M. E. BLAINE was recently appointed Acting Assistant Superintendent of the main line division of the Philadelphia & Reading.

MR. EDWARD SAWYER has been appointed Treasurer of the Montana Central R. R. Co. by President BROADWATER. He succeeds Mr. S. J. BEALS, resigned.

MR. R. I. SLOAN, formerly Chief Engineer of the Manhattan Elevated R. R. Co., of New York City, is now Chief Engineer of the Alley Elevated R. R. in Chicago.

MR. G. G. HAVEN, JR., has been appointed Secretary and Treasurer of the St. Paul & Duluth R. R. Co., with offices in New York.

MR. G. W. SANBORN has resigned his position as Superintendent of the Southern California R. R., and Mr. W. B. BEAMER has been appointed to succeed him.

W. H. WELLS, formerly of Cortez, Col., resigned his office of Chief Engineer of the Colorado Water Supply Co., on April 15, and will open an office in Denver.

MR. GEO. D. WADLEY has been appointed Chief Engineer of the Savannah Construction Co., of Savannah, Ga., which will build the South Bound R. R.

MR. KARL SPORCK has been appointed Resident Engineer in charge of construction work on lines north and west of Springfield, of the Kansas City, Fort Scott & Memphis R. R. Co.

MR. M. S. CONNOR, Division Superintendent of the Cincinnati, Hamilton & Dayton, has resigned to accept the position of General Superintendent of the Peoria & Pekin Union Ry., vice Mr. Thomas B. Burnett.

MR. J. H. BURGHARDT, formerly Division Engineer of the proposed extension of the New York & Massachusetts Ry., has been appointed Master Mechanic, with office at Poughkeepsie, N. Y. He succeeds Mr. J. L. Donaldson, resigned.

MR. GEORGE B. HARRIS, now Vice-President of the Burlington & Northern, was elected Second Vice-President of the Burlington system to succeed Mr. H. B. STONE. He will act temporarily as General Manager of the road until Mr. RIPLEY's successor is appointed. Mr. RIPLEY has been with the Burlington since 1870.

MR. E. P. RIPLEY, General Manager of the Chicago, Burlington & Quincy R. R., has handed in his resignation, to take effect June 1. Mr. RIPLEY resigns to accept the Vice-Presidency of the Chicago, Milwaukee & St. Paul R. R. He will have entire charge of the operating and traffic departments.

MR. CHARLES ACKENHEIL, M. Am. Soc. C. E., Chief Engineer of the Staten Island Rapid Transit R. R. and Baltimore & New York R. R., has removed his headquarters from Elizabeth, N. J., to St. George, Staten Island. His office will be at the general office of the Staten Island Rapid Transit R. R., foot of Whitehall St., New York City.

MR. CHARLES HICKOX died recently at Cleveland, O. He was a director in the Cleveland, Painesville & Ashtabula R. R., now part of the Lake Shore & Michigan Southern, from August, 1851, to August, 1858. He was the vice president from September, 1854, to August, 1858. He and the late Hon. SAMUEL J. RANDALL were members of the board of directors from 1855 to 1858.

MR. R. E. PETTIT, General Superintendent of the Pennsylvania R. R., has tendered his resignation, to take effect June 1. In April, 1868, he was appointed Assistant Engineer and held this position until 1879, when he was made Principal Assistant Engineer. From 1881 to 1883 he was Assistant Chief Engineer, and was then made Superintendent of the New York division. May 1, 1885, he was appointed to his present position.

MR. GEORGE H. BENZENBERG, M. Am. Soc. C. E., has been unanimously confirmed, for the fourth term, as City Engineer of Milwaukee, Wis. The new mayor, Mr. PECK, is especially commended by the press of Milwaukee, for rising above partisanship and reappointing Mr. BENZENBERG, now the only Republican official in the city government. The City Engineer has already served, "with credit to himself and profit to the city," for nine years, and his retention in office is only a sensible recognition of the value of these services.

MR. CHARLES P. TREAT, who has taken the contract to construct the first 15 miles of railway inland from Greytown to the great divide cut of the Nicaragua Canal, with a considerable staff in his and the company's service, sailed on the steamer *Hondo* May 1, for Nicaragua. Mr. TREAT's connection with the work is an assurance that it will be rapidly pushed through. It is a necessary preliminary to starting work on the great cut itself, and also to completing the breakwater, which is so far working precisely as expected in diverting the deposit of sand by the beach currents.

MR. SAMUEL FLETCHER PIERSON died April 22 at Holmesburg, Pa. He was born in Bergen, N. Y., in 1835, and in 1859 entered the passenger department of the Cleveland, Columbus & Cincinnati R. R. His judicial qualities early brought him in connection with the railways in the capacity of arbitrator and commissioner. He was general agent of the Indianapolis Eastbound Freight Association from Aug. 1, 1878, to April 1, 1879, and in June of the latter year he was elected commissioner of the Colorado Pool. He was also commissioner of the pool of the Colorado narrow-gauge roads. In 1883 Mr. PIERSON was called to New York to take charge of the passenger affairs of the trunk line pool. He was made passenger commissioner of the Trunk Line Association in November, 1885, and retired from that place in 1889. He was chosen President of the Pennsylvania, Lehigh & Eastern R. R., which contemplated the building of a road from Port Jervis to Tomhicken, a point on the Sunbury spur of the Pennsylvania R. R. He is said to have been aggressive in the execution of his policy, and his services to the trunk line pool might have been prolonged if he had not been so insistent upon the observance of the agreements that had been entered into, as well as scrupulous in the enforcement of the penalties. He was an earnest worker for the principle of railway cooperation.

PUBLICATIONS RECEIVED.

—*Municipal Engineering.* By W. D. CLARK. Read before the Illinois Society of Engineers and Surveyors. January, 1890.

—*The Ventilation of Buildings.* By ALFRED R. WOLFF, M. E., Consulting Engineer. M. Am. Soc. Mech. Engrs. New York, 315 Potter Building. Price 25 cents.

—*Helena, Montana.*—Issued by the Board of Trade, pp. 36.

This little pamphlet tells a tale stranger than fiction of rapid growth, and gives striking evidence of how fast the far West is developing.

—*The South's Redemption:* From Poverty to Prosperity. By RICHARD H. EDMONDS, Editor *Manufacturers Record.* Published by the *Manufacturers' Record,* Baltimore, Md. Price 25 cents.—A telling exhibit of the advance made by the South in the years 1860 to 1890.

—*The Sewer Gas-Question.*—An Analysis and Illustrated Comparison of the Several Methods of Maintaining the seals of Sewer-Gas Traps. By E. S. MCCLELLAN, M. D., New York. Du Bois Manufacturing Co., 245 Ninth Ave., pamph., pp. 16.

A really instructive and valuable little monograph on this subject.

—*Iowa Society of Civil Engineers and Surveyors.*—Proceedings of the Second Annual Convention, Des Moines, Ia., Dec. 27 and 28, 1889. Price, 35 cts.; 28 pp. Secy., Seth Dean, Glenwood, Ia.

This pamphlet contains the following papers: "Street Pavements," Wm. Steyn; "Race Tracks," R. G. Brown; "Duties of Commissioners in Contested Surveys," F. L. Easley; "Water-Works for Small Towns," M. Tschirgi; "The Law of Accretion," Seth Dean.

—*A Treatise on the Arc Indicator.* Containing simple and complete directions for attaching and using the instrument; reading the diagrams, computing the horse-power, steam consumption, etc., on both simple and compound engines; laying out the theoretical expansion line, and making all calculations necessary in indicator practice. By THOMAS HAWLEY, Editor "Steam Department," *Boston Journal of Commerce,* and published by the *Journal.* Price 25 cents.—A well-written, well-printed and useful publication of 90 8vo. pp.

—*Air-Brake Practice.*—Being a description of the construction, objects sought and results obtained by the Westinghouse automatic air-brake, as well as complete directions for operating it under its many diverse conditions in daily use. By J. E. PHELAN, Hon. Mem. B. of L. E., Mem. Am. Railway Master Mechanics' Assoc., Div. Supt. Northern Pacific Ry. Published by *The Locomotive Engineer,* 96 Fulton St., New York. Price, $1.25.

A handy book to have about, and written for the use of those handling air-brakes.

Transactions of the American Institute of Electrical Engineers, Vol. VI. 8vo, pp. 518 and 161.

Twenty-one papers on electricity, most of them seeming to be valuable, with the discussions, are included in this volume. The last 161 pages are an index to current electrical literature, which in an art advancing as fast as this is a particularly important feature. The Institute now consists of 125 members, 224 associate members and 1 honorary member, or 350 in all.

—*American Water-Works Association.*—Ninth annual meeting, at Louisville, Ky., 1890. Size, 5¾x9 ins.; 144 pp.; Price, 50 cents. Secretary, J. M. Diven, Elmira, N. Y.

This number contains a report of the meeting, and gives the committee reports presented. Also the following papers: "Water-Works Records," J. M. Diven; "Flushing Street Mains," H. W. Ayres; "Liquid and Gaseous Fuels," L. H. Gardner; "Pressure Regulators for Water Mains," Wm. Ryle; "Should a Town Provide Meters to Consumers at its Own Cost," E. Darling; "Analysis of Mechanical Filter Actions," Emil Geyelin; Standard Water Pipes," S. B. Russell; "Relations between Plumbers and Water Companies and Departments," B. F. Jones "Notes on the Distribution of Water Supply in Cities," S. Tomlinson (Bombay Water-Works); "Pure Feed Water for Boilers," F. W. Gerecke; "Hardness of Waters,' A. R. Leeds.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of business meeting, April 19, 1890. President H. W. Spangler in the chair; 23 members and 2 visitors present. The Secretary presented the report of the Board of Directors on the matter of the revision of the rules for the qualifications and election of members, which had been referred to the Board. The Board had decided to lay the matter on the table. The Secretary moved that this report of the Board be accepted, and that their action in the matter be approved. This motion was seconded by Mr. Wilfred Lewis, and, after some discussion, was carried.

Mr. Wilfred Lewis presented a description of a new shaft coupling for the transmission of power to traveling cranes, etc. The description was illustrated by a number of interesting specimens. An illustrated paper on the purification of water by means of metallic iron was read by Mr. Easton Devonshire, Assoc. M. Inst. C. E., England, visitor to the Club. The objection to the use of ordinary sand filters as practiced in Europe, and the mechanical difficulties attending the use of chemically acting materials, such as spongy iron, when disposed in filter beds, were pointed out, the sand filters becoming foul and the purifying material rapidly losing its porosity and eventually its chemical activity. A description was given of the method invented by Mr. William Anderson, M. Inst. C. E., England, for overcoming the defects of filter beds by placing metallic iron, in the form of cast-iron borings or plate punchings, in a revolving cylinder, through the hollow trunnions of which water is caused to flow, the iron being continuously showered down through the stream of water. By this method, it is said, the particles of the metal are brought into intimate contact with the water, and by rubbing against one another present clean surfaces at all times. The action of the revolving purifier causes the formation of a protosalt of iron which, on aëration, creates a coagulating precipitate of ferric oxide. Special reference was made to the application of this process to the water supply of Antwerp, Belgium, and figures given showing that from a much polluted river water of a high standard of purity is supplied to that city at a low cost.

HOWARD MURPHY, Secretary and Treasurer.

American Society of Mechanical Engineers.—The annual meeting will be held at Cincinnati, O., May 13, 14, 15 and 16. Visits will be paid to engineering works and points of interest. Reports of committees will be presented, and the following papers are on the programme:

"The Measurement of Durability of Lubricants,' J. E. Denton.

"Some Experience with Crane Chains," G. S. Dutton.'

"Memoranda on Indicating the Engines of the Steamship *City of Richmond,*" Geo. H. Barrus.

"The Efficiency of Locomotives," W. F. Dixon.

"Working Railways by Electricity," Willis E. Hall.

"Determination of Sensitiveness of Automatic Sprinklers," A. F. Nagle.

"Tests of Several Types of Engines under conditions found in actual practice." R. C. Carpenter.

"Comparative Tests of a Hot Water and a Steam Heating Plant," R. C. Carpenter.

"Note on Kerosene in a Steam Boiler," R. C. Carpenter.

"Peclet's Treatment of Chimney Draft," J. B. Webb.

"The Mechanical Theory of Chimney Draft," J. B. Webb.

"Graphic Representation of Thermodynamic Quantities," De Volson Wood.

"Chimney Draft," De Volson Wood.

"Test of a Refrigerating Plant," De Volson Wood.

"Hirn and Dwelshauvers' Theory of the Real Steam Engine," R. H. Thurston.

"A Universal Steam Calisimeter," Geo. H. Barrus.

"Heating Furnaces," D. K. Nicholson.

"Equilibrium Arch Curves," H. H. Suplee.

"The Kinzua Viaduct, 1882," T. C. Clarke.

"The Length of an Indicator Card," J. B. Webb.

"Indicator Cards of the Pawtucket Pumping Engine," D. S. Jacobus.

"The Effective Area of Propeller Screws," D. S. Jacobus.

"A Use for Inertia in Shaft Governors," E. J. Armstrong.

"A Governor for Steam Engines," Jesse M. Smith.

"Effect of an Unbalanced Eccentric in Shaft-governed Engines," Jno. E. Sweet.

"An Open-end Mercury Column for High Pressures," W. W. Bird.

"An Automatic Absorption Dynamometer," G. I. Alden.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIII. Saturday, May 3, 1890.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting, May 8. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, May 5. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, May 5. "The Evolution of the Elevator," R. M. Sheridan. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, May 6. Secy., C. O. Palmer, 22 Cedar Ave.

Engineers' Club of St. Louis, Mo.—Next meeting, May 7. "Compound Locomotives," A. T. Woods; "Granitoid Curb and Gutter," Otto Schmitz. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, May 7. Annual convention, at Cresson, Pa., in June. Secy., John Bogart, 127 E. 23d St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, May 8. Secy., Olin H. Landreth, Vanderbilt University.

American Society of Mechanical Engineers. Annual meeting at Cincinnati, O., May 13 to 16. Secy., F. R. Hutton, 64 Madison Ave., New York, N. Y.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, May 14. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, May 14. "Length of Rigid Wheel Base Permissible on American Railways for Locomotives, Tenders or Cars." Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

New York Railway Club.—Next meeting, May 15. Rooms, at 118 Liberty St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, May 15. Secy., Clement March.

American Water-Works Association.—Annual meeting at Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

Western Railway Club, Chicago, Ill.—Next meeting, May 20. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, May 20. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, May 21. Secy., S. E. Tinkham, City Hall.

Western Society of Engineers, Chicago, Ill.—Next meeting, June 5. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, June 6. Secy., E. K. Smoot, Elm and Austin Sts.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W Cloud, Buffalo, N. Y.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

If any reader of this journal knows of one or more well-authenticated instances in which a car has been set on fire in a collision or derailment by kerosene or other oil lamps containing oil of 300° or any other fire proof, or if any reader can learn of such an instance by inquiry among other railway officers, we shall be particularly obliged for a statement of the facts, which will, if desired, be treated as confidential, as respects the place and date of the occurrence. By diligent inquiry, extending over a series of years, we have not been able to learn of a single such instance where the facts were clear and well authenticated.

Instances are also desired where cars have been set on fire by accidents to lamps, without any train accident, but less urgently, as these are known to have occurred, and in at least one instance with grave loss of life. It is suggested that the evidence must be very clear to show that lamps were the cause of fire, when stoves of any kind were also in use upon the cars.

This notice is reproduced from our last issue, and will be published again next week.

The compound locomotive has plainly come to stay. We give in this issue a good deal of definite information as to recent experience with it, especially in the discussion of German engineers headed by the title of "Compound Locomotives in Germany." A striking evidence that the type is fast advancing into public favor is, that one at least of our great lines is seriously studying the question of how to convert its entire stock into compounds. It is not yet easy to say what will be the final type of compound locomotives, but the general belief is that it will be of the original Mallet type, with two unequal cylinders, one on either side. It sems improbable that it will be of the three-cylinder Webb type, ingenious as that system is. It is quite certain, at any rate, that the experience of the Pennsylvania Railroad with the single engine of that type imported for trial, was anything but favorable to it under the conditions of American service, as was noted in last week's issue in "Notes by Rail." The four-cylinder type, illustrated in another column, seems likely to prove more successful.

It is undeniable that railway mechanical officers are prejudiced against four-cylinder locomotives, on the ground that they must necessarily be a great deal more complicated than the simple engine. It will probably surprise many, therefore, to know that the makers of the four-cylinder compound, illustrated on our inset page this week, state that:

"The engine was designed to meet the demand for a simple method of compounding the present American engine, to realize the maximum economy at the least expenditure, and to provide a method of construction applicable to all existing types of American locomotives.

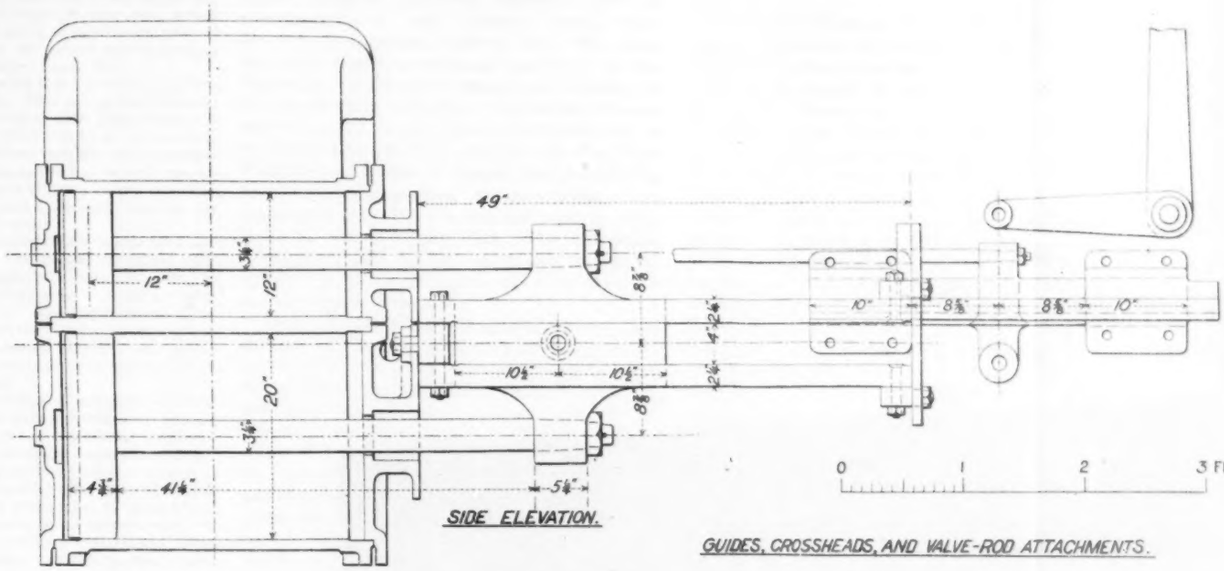
The drawings of the engine show that if the four-cylinder compound is not a simpler machine than the two-cylinder, the additional complexity is hardly enough to be of much importance. There are two additional pistons with their fittings, but they are only 12 ins. in diameter; the other extra expense arises from boring the 12-in. cylinders and making and fitting the cylinder heads. The crosshead is also a little more expensive than in the common engine. As for the valve and valve gear, they are said by the makers to be less expensive than on the ordinary locomotive, and that they are much more durable, require less power to work, and distribute the steam much better, will hardly be questioned. These results are gained by dispensing with rock-shafts, and working the valve-rod direct from the link-block, by using extra long ports, which are easily obtained with the cylindrical valve, and by avoiding all friction due to unbalanced or imperfectly balanced valves.

We have pointed out elsewhere more in detail other special features of this locomotive's construction and performance. It would be too much to say that its excellent showing will settle the question of compound locomotives in favor of the four-cylinder type, for the two-cylinder compound built at the Schenectady Works, and illustrated in our issue of March 2 is making excellent records; and, as already stated, a popular prejudice exists, we believe, among master mechanics against the four-cylinder locomotive. But the success of this engine and the simplicity of its design does open the question as to which type is, on the whole, better, and further tests as to the performance in actual service of either will be awaited with interest.

The Board of Trustees of the New York and Brooklyn Bridge have added the last touch to their brilliant record by gravely proposing, in a bill which they have caused to be prepared and sent to Albany, to seat their Chief Engineer and Superintendent, Mr. C. C. Martin, *in the chair* of a new board of three experts, which is to say whether the last Board of Experts (which reported over two years ago) was wise in rejecting Mr. Martin's plans, and also whether or not the trustees acted wisely in adopting his plan nevertheless, as they did two weeks later on *ex parte* procedures, the empty formality of first consulting their own Board of Experts and giving the author of the recommended plan a hearing being neglected. The opinion of one member of the proposed Board of Experts on this point can be predicted with considerable certainty. The folly and impropriety of such an appointment is only partially paralleled by supposing a law to be urged seating the disappointed contestant in a lawsuit as chief of a court of appeals to revise the findings in his own case.

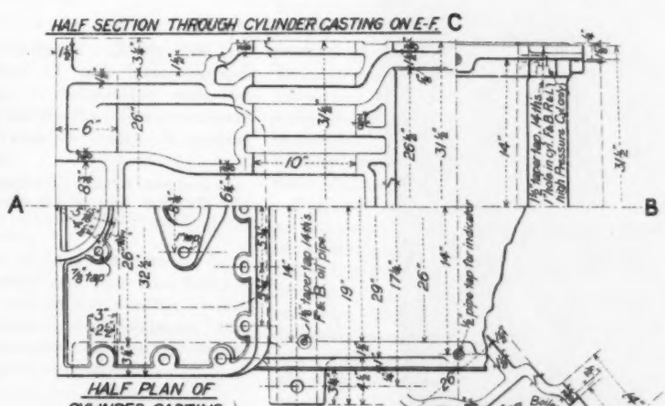
Any one who accepts a position on a Board of Experts assumes in effect judicial functions, and it is as contrary to reason and justice for an engineer as for a judge to assume such functions when he is also an interested party in the decision. In this case, it is simply impossible for a man who has been connected with the problem as Mr. Martin has to approach any other view of it but his own with a fair, unbiased mind. He, therefore, should not serve. We say nothing as to the correctness or incorrectness of his views; but he is certainly not the man to judge of them judicially. They now stand as "adopted," and have for over two full years. He has full power to carry them out, if he pleases, without consulting any one. If he fears to do this, or has found out at last what we pointed out two years go, that he cannot do it without immediate disaster, he certainly is not a competent nor proper person to consider without prejudice what other thing should be done. We forbear further comment beyond giving in another column what some of the daily journals think of this strange proposition.

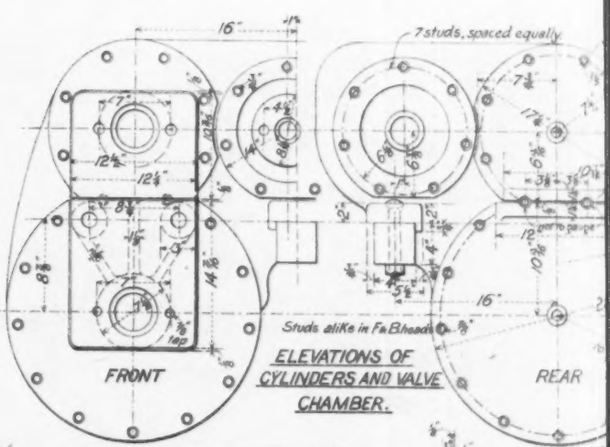
"The mills of the gods grind slowly," but in the end they are credibly alleged to grind tolerably fine, and the latest indications are that the Board of Trustees of the Brooklyn Bridge is to be ground out of existence. It has been a curious body. It apparently fancied that all it had to do was to "adopt" a plan, and that would end the matter, like the Pope's bull against the comet. But the plan it "adopted" two years ago in despite of advice of its own seeking, is to-day no nearer to being put in execution than it was then, and is just as absolutely unworkable to-day as we told them it was then, when they refused to listen to us. "Experience keeps a dear school," but every one must learn from it at last, though he can do as he pleases about learning from this journal.



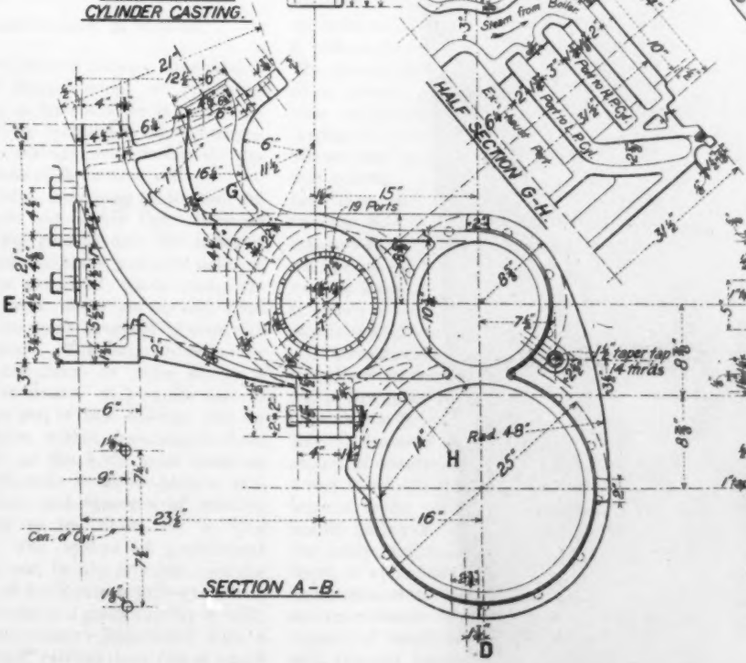
SIDE ELEVATION.

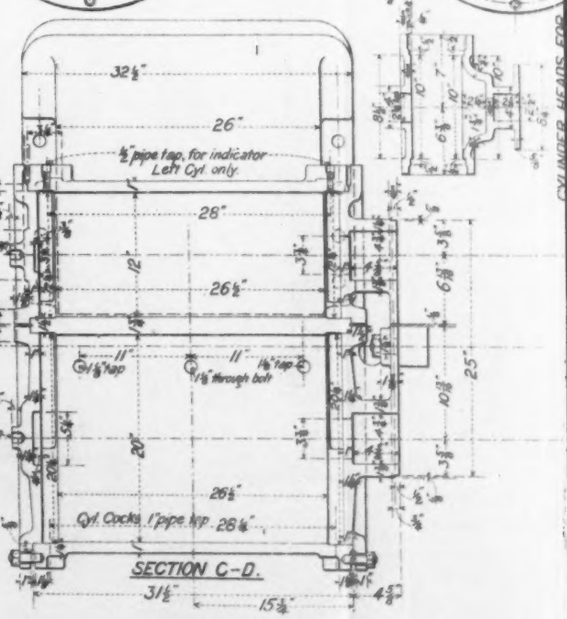
GUIDES, CROSSHEADS, AND VALVE-ROD ATTACHMENTS.





ELEVATIONS OF CYLINDERS AND VALVE CHAMBER.





CYLINDER HEADS FOR

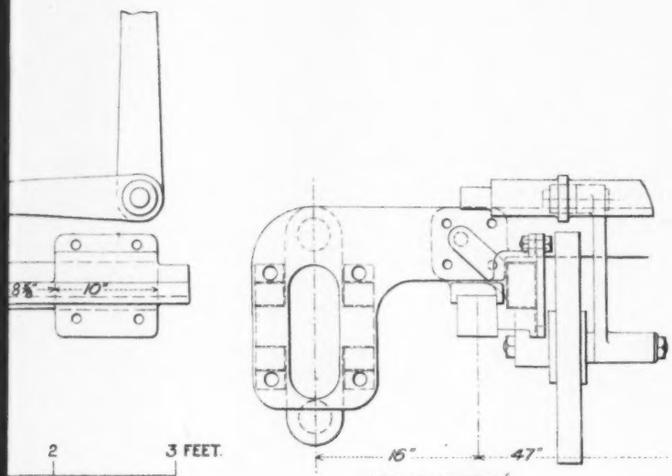
THE BALDWIN COMPOUND LO

DESIGNED AND BUILT BY THE BALDWIN LOCOMOTIVE W

FOR THE

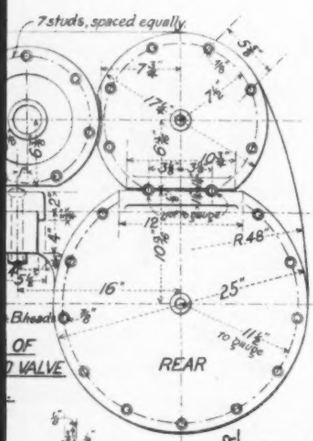
BALTIMORE AND OHIO RAILROAD

CYLINDER AND VALVE DET



END ELEVATION.

TTACHMENTS.



OF
D VALVE

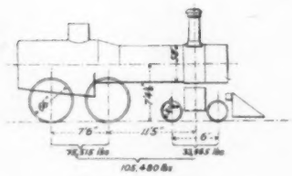
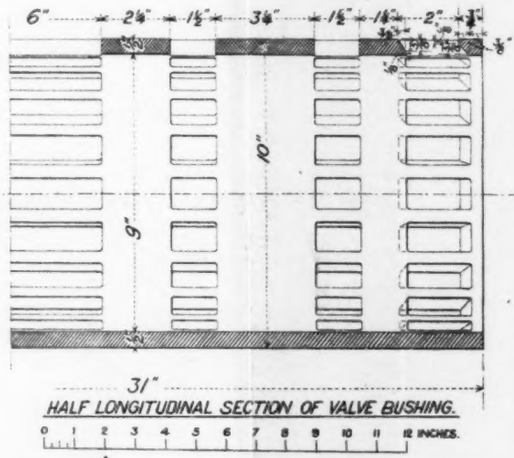
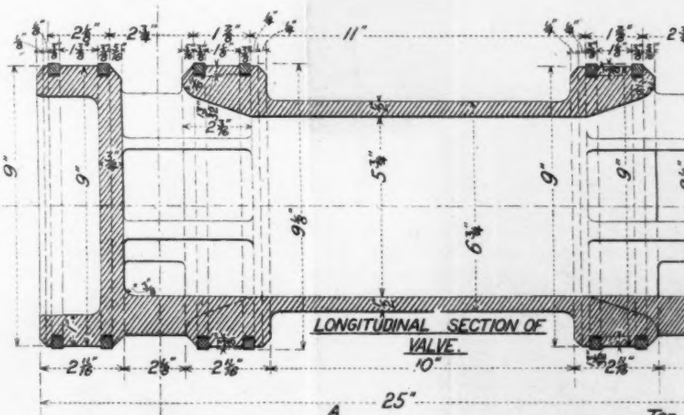


DIAGRAM OF LOCOMOTIVE,
SHOWING
WHEEL BASE AND WHEEL LOAD

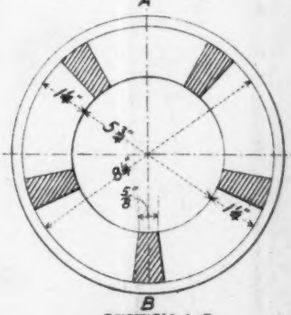


HALF LONGITUDINAL SECTION OF VALVE BUSHING.

A



LONGITUDINAL SECTION OF
VALVE.



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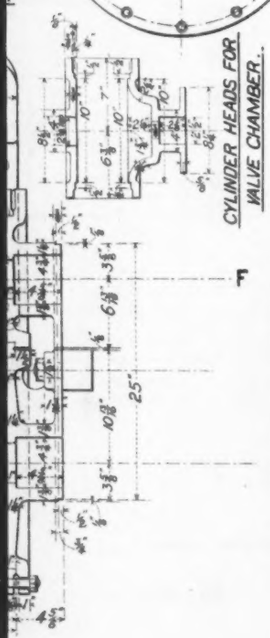
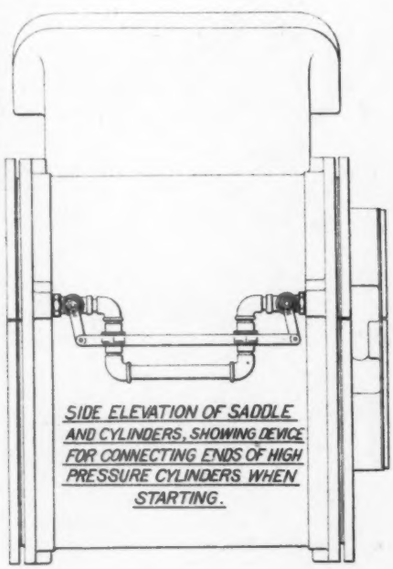
SECTION A-B.

FRONT END E



CYLINDER HEADS FOR
VALVE CHAMBER.



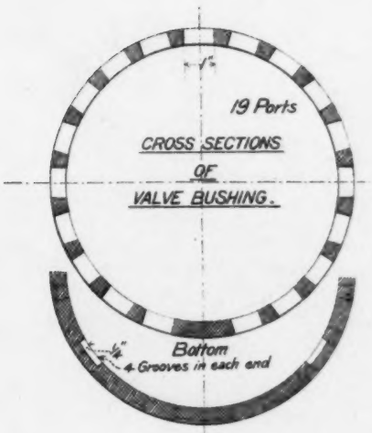
SIDE ELEVATION OF SADDLE
AND CYLINDERS, SHOWING DEVICE
FOR CONNECTING ENDS OF HIGH
PRESSURE CYLINDERS WHEN
STARTING.

ND LOCOMOTIVE.

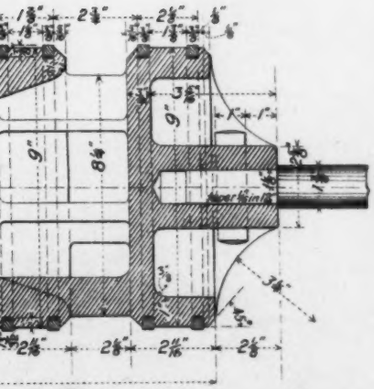
OTIVE WORKS, PHILADELPHIA, PA.

RAILROAD.

VE DETAILS.



CROSS SECTIONS OF VALVE BUSHING.



Top.

FRONT END ELEVATION.

SECTION AND PLAN OF VALVE RING.

CHAS. HART & SONS, LITH., 99 VESEY ST., N.Y.

The Brooklyn *Times* hits off the sapient board pretty well in the following comments:

We find in the New York *Times* an expression of opinion about the Bridge Trustees and their action so just and luminous, so kindly and moderate in tone and, within small compass, so comprehensive of all the branches of official mismanagement that we cannot forbear quoting it in full: [Reprinted on another page.—ED.]

It must of course be conceded that the bridge trustees are not universal blockheads. They are, on the contrary, successful and intelligent business men, highly informed upon special subjects. One knows all about the publishing of books, another all about cast iron work, another about the wholesale oil trade, and so on. In their specialties they are experts, but none of them knows anything about managing a railroad, and, apparently, they are not willing to trust those who do know.

They are like the man who went to a doctor for a prescription for heart disease. The doctor prescribed digitalis and other things. "Digitalis be blowed!" said the man when he left the consulting room. "What I want is a brandy cocktail after meals." The KATTE Board of Experts prescribed digitalis, and the Board of Trustees have been figuratively firing in brandy cocktails ever since, with the result that the last state of that bridge is considerably worse than the first.

It's all nonsense to have a board of eminently respectable wholesale merchants and book publishers to manage the bridge. The bridge is a purely engineering structure, and it will never be rightly managed until expert engineers are in control of it. If an expert board of three is to examine plans and report, Superintendent MARTIN should not be one of the three. The proposition to make him a member of the Board of Experts is an insolent one. No other word will describe it. Perhaps the JACOBS bill as it stands is better than nothing, but this particular provision of it is rotten bad.

What is wanted is an expert salaried board of three engineers. The bridge must be finished.

We find in the "Summary for March, 1890," of the "Central Office of the Meteorological Bureau," which acts in coöperation with the United States Signal Service, the following curious statement, which seems to involve a certain mathematical anomaly:

The weather predictions for this month have been verified as follows: For weather 84.3 per cent. were fulfilled; for temperature, 87.3 per cent.; for weather and temperature combined, 85.5 per cent.

How 85.5 per cent. of the predictions for both weather and temperature could have been fulfilled when only 84.3 per cent. of the weather predictions alone were fulfilled, is what puzzles us. But as this summary emanates from Cornell University, we presume, both figures are correct.

Railway Construction in Mexico.

The maps and statistics of railway construction in the Republic of Mexico which we present in this issue show that at present there is considerable activity in railway building in that country—a very remarkable activity, considering the dubious financial results of the active railway construction of 1880–1885. According to the list, 410 miles of track were laid during 1889. Between Jan. 1, 1890, and the present date 214 miles of track have been laid, and there are 1,625 miles of railway in various stages of construction, 448 miles surveyed or now under survey and 3,649 miles projected with some prospect of construction in the near future. The large mileage now actually under construction or under survey is noticeable in this summary. It is quite safe to say that the greater part of this mileage will be carried to completion within a reasonable time. On the other hand, of the 3,649 miles noted as projected, very little aside from the portion projected as extensions and branches of existing roads seems likely to be built for a long time to come. The system of government concession carried out by the Republic, and the rapid development of the Mexican railway system, has tended to give rise to a great number of wild, cat schemes; and the country is covered with a network of "projected" railway lines, few of which will soon reach even the dignity of a survey. Taking, however, the roads which are practically sure of being constructed, the showing is very favorable, and speaks well for the future development of the country.

Taking up the various enterprises somewhat in detail, probably the most important piece of construction is the system being built by the Interoceanic Railway Co. The main line of the road is to run from Vera Cruz, on the Gulf coast, via the City of Mexico, to Acapulco, on the Pacific coast, forming a connection between the two oceans. Only a short portion remains to be finished in order to complete the road from Vera Cruz to the City of Mexico, and tracklaying on this is now in progress. On the extension west construction is also in progress and work is being done on several branch lines. The road being through a thickly settled region and connecting the chief port with the capital, the prospects for a paying business seem good.

Among the other lines forming interoceanic connections the Tehuantepec and the Mexican Pacific railways are the most important. The former is being built by the National Government across the isthmus of Tehuantepec between the cities of Coatzacoalcos and Tehuantepec, a distance of 207 miles. About 67 miles of the line are already completed; 38 miles of this distance being on the Pacific coast and 29 miles on the Atlantic. Construction is in progress between the ends of track. The latter road is under construction from Tonala, on the Pacific, to Frontera, in the State of Tebasco, a distance of 400 miles. Both lines are being built to provide interoceanic communication and as rivals to the Panama Railway. Another line now being rapidly built in the southeastern portion of the Republic is the Mexican Southern. This road is projected to run from Pueblo southeast to Oaxaca, a distance of 249 miles, and 139 miles from Pueblo south are under construction. The road is being built to develop the agricultural lands tributary to its route, and to open up the rich mines in the State of Oaxaca.

Passing to the northern portion of the country, we find only two enterprises of much importance. In the northeast the Monterey & Mexican Gulf, and in the northwest the Sonora, Sinaloa & Chihuahua. The Monterey & Mexican Gulf Ry. runs from Venadito, via Monterey, to the harbor of Tampico, a distance of 495 miles. About 214 miles of the road are now completed from Venadito southeast, and the remainder is under construction. The road is through some of the finest agricultural and timber lands of the country, which it will connect by a short line with the Gulf coast. The Sonora, Sinaloa & Chihuahua Ry. is projected to connect the city of Chihuahua with the coast at Guaymas, and to afford a line passing through the mineral section of the State of Chihuahua and connecting with the American railway system. A large amount of surveying has been done, and the line has been graded from Deming, New Mexico, to the international boundary, and from Guaymas east about 30 miles. The road passes through the rich forests of Sonora and mineral lands of Chihuahua, and will undoubtedly obtain a large traffic in ores, bullion, cabinet woods and agricultural produce.

Of the older lines, the Mexican Central has just completed its branch to Tampico on the Atlantic, and is now pushing construction on a line from Guadalajara to the Pacific Coast at San Blas. The line to Tampico passes through a naturally rich section of country, and will, it is expected, obtain a very fair traffic in agricultural products, salt and tropical fruits. Work is now in progress improving the harbor of Tampico by dredging and building jetties, which, when completed, will assure a depth of water sufficient for the largest ships. The completion of the Guadalajara extension will give an interoceanic line passing through a region capable of much development in its agricultural and mineral resources. The Mexican National has under construction a branch to the Pacific coast and also a line to open up the mineral regions of San Luis Potosi and Tamalipas.

The Yutacan lines are local enterprises, being built principally with the object of transporting the sisal crop, which is the staple product of this State.

Nearly all of the lines mentioned penetrate sections of the country of sufficient natural wealth in minerals, timber and fertile lands to furnish a good traffic, when properly developed. The lines themselves will be the main factors in this development, by opening up the country to the outside world, and giving the capital and energy which are building the railways, a chance to reach portions of the country heretofore practically inaccessible.

The full significance of the persistent activity in railway construction in Mexico cannot be appreciated without remembering that Mexico is not a country of such enormous natural wealth still undeveloped as is commonly supposed. The first impression of almost every visitor who sees the country for the first time is one of disappointment. The country looks even poorer to him than it actually is. There is no natural green sod and grass, no trees visible nor existing except along the coast in the *terra caliente* and on the remote summits of the mountains, no coal, and no houses scattered about over the fields. The whole population is concentrated in towns and villages, and the country, as one rides through it, has a barren, deserted look, except in the occasional irrigated valleys, whose vivid beauty and fertility makes a startling contrast, but which are of small extent in actual area. Moreover, the country actually is more developed in proportion to its capabilities than most people fancy; and it takes a considerable residence to appreciate that there is an enormous chance for future development after all. The great field is in agriculture, in Mexico as elsewhere. In numerous localities, mostly away from the railways, marvelously elaborate and effective irrigating works exist, but by larger investments of capital the irrigated area can easily be multiplied tenfold, with enormous addition to the wealth of the country. The access of railways, with the chance of getting coal for fuel at something like a reasonable price, is also greatly stimulating mining, and must result in very great increase in the products and profits of the mines.

There is no such great store of undiscovered bonanzas, however, as conceited American explorers imagine. There probably is no equal area on the earth which has been better prospected in the last three centuries than Mexico. It may be counted on with considerable confidence that unworked mineral deposits which could be worked with profit under former conditions will be very hard to find, and the Mexican "beneficiating" or reducing works, moreover, were and are as effective as any known to science under the conditions which obtained there: viz.: no power of any kind possible except that of animals. A few pumping engines have been at work there for a long time, but they were installed at enormous cost, and kept working by wood hauled long distances on the backs of men and animals, making the cost of fuel considerably more in instances than coal at $50 per ton.

Only the richest mines could stand that, and, as a rule, water was pumped out by bullock-skin buckets hoisted by animal power, and when the flow was too great to be thus mastered, the mine was abandoned.

Under these conditions coal at even $20 a ton, hauled a thousand or more miles, is a considerable boon, and it may be counted on with confidence that the silver product of Mexico will continue to increase, and that many mines once abandoned will start up again, and many deposits too poor to work under former conditions will be rediscovered and opened up. The change from the frightful condition of chronic revolution which existed until 20 years ago is also a great stimulus whose effect is not yet exhausted. Men have not yet begun to realize that the condition of Mexico is

hereafter to be as certainly peaceful as that of this country, but they realize it more fully every day.

These causes are encouraging, and maintaining the continued activity of construction which we chronicle this week; the conclusion of the whole matter being that while Mexico has vastly fewer neglected opportunities for wealth-production than those who have never seen it fancy, it has vastly more than those who only examine it from the car window realize.

New England Notions as to Car Couplers.

We have received lately a neat bit of yellow-covered literature, appearing on its face to be an official report of the extraordinary proceedings at the New England Railroad Club reported and commented on in our issue of March 22, but in fact anonymously issued by some one opposed to the M. C. B. type of coupler. We notice in it certain misrepresentations in regard to this journal which before had escaped us. At the end of the meeting a paper was read by Mr. F. D. ADAMS, stated to to have been prepared by Mr. JOHN M. FORD, in which the author coolly declares:

"The editor of ENGINEERING NEWS, in its issue of Feb. 15, 1890, has published a record of defective M. C. B. couplers in service, and has, with a minuteness of detail, made calculations with a lot of *assumed figures*. . . . His source of information, he claims, must be reliable, because it comes from the manufacturers direct."

This is a misrepresentation out of the whole cloth. We will charitably assume that it is unintentional, but it is in any case one of which the author ought to be ashamed, and we trust will be. We did not claim that the information must be correct because it came from the manufacturers, but because the original records of individual fractures came to us directly from the companies, without the manufacturers having anything to do with them, in the case of two of the most important lines, while in the case of the others the same records of individual fractures came to us *through* the manufacturers, it is true, but not "from" them, direct from the separate companies, in such manner as to give us, and any other intelligent person who is not over-anxious to blind himself to facts, positive assurance that the records must be full and complete for the specific companies mentioned, or the deficiency would be instantly exposed by inquiry from any quarter.

Now, what were these records? Full reports by 11 companies of all breakages of Janney couplers on the 21,507 miles operated by them, these roads having had for an average of 9.34 months, 45,617 couplers in use. Reports seeming to be less complete from as many more companies, having 22,026 more couplers in use, were neglected altogether. With a truly remarkable agreement among the different companies with the average results, these records showed that, taking all the breakages occurring on all these lines together, 1 per cent. of the couplers and 3 per cent. of the knuckles were found to be breaking yearly, making the *present* maintenance rate per car only 29 cts. We stated then at some length, and we repeat now, that this seems to be and is quite too good to be true as a permanent average; but we then showed also that this was but one-seventh part of the actual cost of links, pins and broken drawbars on one of the prominent lines reporting, which is rather less than more than the general average.

Now, in the face of these figures, along come officials of a minor road (for such the Boston & Albany is in comparison with the great systems above) operating not 21,507 but barely 200 miles of main line, and having not 45,617 Janney couplers on its own cars, but not a single one, and declares that in two months it had 296 fractures of Janney couplers, whereas the 11 companies operating 21,507 miles only reported 1,469 fractures in 9½ months. Supposing that this statement of the smaller road is literally accurate as to time and number of fractures, which we greatly doubt, what do these facts prove? Nothing, surely, but that out of its own mouth the small road is condemned of needlessly rough usage of couplers, since other roads of fifty times their mileage and traffic, seem to avoid such results easily enough.

For, it is evident that, even allowing that many of the 67,643 couplers reported on were scattered on foreign roads and so not reported, these roads must have had at least a hundred times as many couplers on their road as had the Boston & Albany (which is expressly stated to have been receiving and delivering hardly more than 10 M. C. B. couplers of any kind daily). If, then, this great system of 21,507 miles swarming with Janney couplers could only discover 1,469 breakages to report in 9½ months, or 157 per month, how does it happen that the Boston & Albany could scrape together nearly as many (148 per month) with only a few straggling cars on its road out of the vast number in service?

Consider, for instance, specific roads. The Chicago, Burlington & Quincy, operating 4,917 miles, with 1,183 couplers of its own in use and thousands more constantly on its road from other lines, reported to us direct that it had only been able to discover 49 breaks of Janney couplers in six month's service, or eight per month. Will any one believe that the Boston & Albany averaged more Janney cars on its lines than this great system, or a half or a tenth so many? And yet its officials would have us believe that their eyes were sharp enough to discover 148 breaks per month in their few Janney cars, which would be at the rate of fully 1,000 per month, instead of eight on the Chicago, Burlington & Quincy!

What we suspect to be the case is that the statement of 296 broken Janney couplers, and 347 M. C. B. couplers of all types, which the Boston & Albany officers state in italics is "for *two months*," is in reality a lot of breakages *collected* in two months from breakages which had been occurring for two or three years. That there is no such experience in the rest of the country is sufficiently evident by referring to the map in our issue of Dec. 21, 1889, showing the rate of introduction of automatic freight brakes and couplers. New England cuts a poor figure in this map, being almost a blank as respects brakes, and quite a blank as respects couplers; but the rest of the country is covered thick with red and green lines. It is notorious that the lines thus shown are the very lines which have been most extensively experimenting with the M. C. B. type of coupler for the past three years. It is equally notorious that in the four or five months which have elapsed since our brake and coupler map was issued numerous very heavy orders for further equipment of cars have been placed, and that the application of M. C. B. couplers has been going on at a more rapid rate even than last year. According to the very full returns we gathered, 6,000 cars were equipped before 1888, 15,000 more during 1888, 39,000 more during 1889. Abouttt 60,000 more will be equipped during 1890, unless the present rate falls off sharply. Not a single line which had used M. C. B. couplers on a sufficient scale to figure on our map (at least 500 cars per 1,000 miles of line) is known to have stopped applying couplers. Who, then, in view of these facts, is most likely to be acting intelligently; the men who have persisted in applying more and more couplers on such a vast scale during the past three or four years, or the man who could gravely write or endorse the following ridiculous paragraph from the paper referred to, whose extravagance defeats itself:

If it costs for two months, on 200 miles of road, $2,038.20, it would cost for one year $12,229.20. This would give the cost per mile. per year, $61.14. Poor's Manual gives, in the report of 1888, 156,082 miles of road in the country. If, therefore, one mile of road costs $61.14 per year, 156,082 miles would cost $9,542,835.48. Now, the editor of the ENGINEERING NEWS claims that there are about 56,000 cars, in round numbers, equipped with the M. C. B. coupler type.

It would, therefore, cost per year to MAINTAIN the M. C. B. coupler on this 56,000 cars, *per car*, $170.40, or between six and seven sets per car per year. There is estimated to be about one million freight cars in service in the country. When they are all equipped with this type of coupler, if the figures presented can be relied on, the cost of *maintaining* the M. C. B. type of coupler in the country, *per year*, would be $170,000,000.00, in round numbers.

The real meaning of such nonsense as this, and of the apparent pleasure with which some New England men listened to it, is simply that we are now having another example of that strange backwardness in railway betterments for which New England has been unpleasantly conspicuous in the past, and which is in such strange contrast to the general characteristics of that region that it is difficult to account for it satisfactorily. It is a fact, however, that long after the Westinghouse brake and the Miller platform were in all but universal use in the rest of the country, the New England roads stolidly refused to have anything to do with either of them, until a score or two of lives at Revere paid the forfeit of their obstinacy, and drove them from their folly. The same was true of train handling. The modern system of train despatching was there absolutely unknown, when it was universal elsewhere. The Revere accident was the direct result of such primitive practice, in which the telegraph was ignored, as Commissioner ADAMS pointed out at the time with no small emphasis. So of bridge-building; such a nondescript structure as the Bussey Bridge could hardly, by any possibility, have existed outside of New England. At any rate, it never did exist. So of its rolling stock, which for the most part (with notable exceptions) has been inferior to that further West. Now we are being treated to another outbreak of this same spirit in the action on the automatic freight brake and coupler question. What should be and must be done is already ancient history in the rest of the country, but the New England officials still shut their eyes to facts, and hug the delusion that there is not going to be much of a flood after all.

It is true that in the matter of steam heating New England has been doing well, and is fully abreast with the rest of the country. We give her full credit for this, but on the other hand we cannot forget that there is a reason for this. The two frightful disasters at White River and the Bussey Bridge, which finally made it certain that the car stove must go, were both in New England, and naturally had most effect locally. The Railroad Commissioners of New England always have been and are now in the fore-front of progress on these matters, which makes it the more surprising that the corporations themselves tend to lag so wofully behind.

Notes by Rail.

[EDITORIAL CORRESPONDENCE.]

THE CAR SHOPS AT ALTOONA.

The Pennsylvania R. R. Co. carries no insurance on its buildings, considering that in the long run when it foots the bills on its own losses, its insurance expenses will be much less than if it adopted the usual course and paid in annual premiums not only its share of the losses, but the insurance companies' expenses and profits as well. Where this policy is adopted I think it is also true that more care is taken to secure efficient fire protection.

In the Altoona yards, near the car shops, is the fire headquarters. Here are three steam fire engines and two chemical engines, while a third chemical engine is kept at the locomotive shops. The fire organization is made up from the men employed in the shops, but it is kept up to a high state of efficiency by frequent drills. Of course, from the nature of the work, a fire can hardly gain much headway during working hours. Most fires start during the night, often from spontaneous combustion, but the shops are kept thoroughly patrolled by watchmen, and these fires are generally put out as soon as they start.

The main freight carshop at Altoona is an annular structure with radial tracks running to a large turntable in an open space in the center. This turntable is driven by a small steam engine which is set on an arm at right angles to the axis of the turntable and resting on a single drive wheel. This runs on a circular rail about 8 ft. from the edge of the pit. When the turntable was erected it was intended to operate it by hand in the ordinary way, but it was a difficult matter to balance it and so many men were required to turn it that the engine was added, and now one man operating the engine locks, unlocks and turns the table with much more dispatch as well as more economically than by the old hand system. I was told that this table once ran away and spun around at a very lively rate before it could be stopped.

The piece work system is in almost universal use at Altoona. Even in the freight car repair department, each detail has its price. The difficulty of arranging a schedule of prices which will cover accurately all the various repairs seems great; but it has been done, and I am told with satisfaction to both the company and the workmen.

I saw several box cars in which the excellent Howe truss type of side body trussing, invented by Mr. JOHN W. CLOUD, was being used. This trussing allows the shrinkage due to seasoning to be taken up very readily.

For putting on siding a rather small wire nail, with a barbed shank, is used, and I was told that its holding power was almost equal to that of a screw. This is certainly contradictory to the very full and exhaustive experiments made many years ago at the St. Louis bridge, which showed that any jagging or barbing of the shank of a bolt or nail decreased its holding power over that secured by the same shank without the projections. If these barbed nails really hold more than the plain nail (I did not learn whether any tests have been made) it is probably because their small size permits the barbs to enter with little disturbance of the fibre.

A good many cars were being fitted with the Graham draft rigging, and I am told that it is giving very good satisfaction in service.

The shops are crowded full of work, especially in the passenger car department, where 140 new cars are now being built. As many new cars as the shops can turn out are urgently needed for the traffic.

It may not be generally known that the Pennsylvania is taking the lead in an important reform in brake practice. All new six-wheel trucks and all six-wheel trucks passing through the shop have a brake shoe applied to every wheel.

One wonders why the enormously wealthy Pullman and Wagner companies can't adopt this inexpensive improvement to increase the safety of their passengers. Another new feature of brake practice is the provision of a brake shoe for each side of the wheel on all new four-wheel passenger trucks. While this does not add anything to the braking power, it doubles the life of brake shoes, avoids so frequent changing, and perhaps has other good features.

Some very handsome dining cars, finished in white mahogany, were nearly ready for the painter. These cars are 62 ft. over all and very strongly built. I strongly suspect that the profits in hauling these heavy cars and furnishing meals at $1 each must be very small.

A novel style of horse-car has recently been built, having removable partitions dividing the car into stalls. When the car is to be used for ordinary freight the partitions are easily removed and packed in one end. About 30 of these cars have been built.

All hand and push cars for the road department are built in these shops. All hand cars are made to drive with the pump gear. The standard car weighs about 800 lbs.

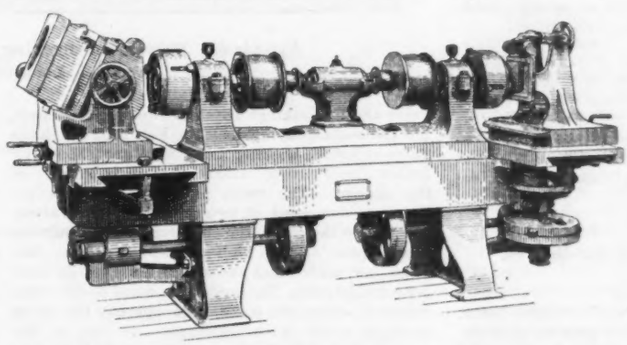
The forge shop very well fitted up with appliances for drop forging. The work on various parts of the link-and-pin coupling, which forms a good proportion of the total output of the shop, is especially interesting. No less than 400,000 pins and 200,000 links is the present average annual requirement of the Pennsylvania Railroad. The links are welded by a drop at a cost of 1¼ cents each, and will stand a tensile strain of about 85,000 lbs.

The "bull-nose forgings" are made complete here from scrap iron, at a cost, including labor, coal, material (scrap at ¾ of a cent per lb.) and clerical force, of $2.95. The forging weighs 74 lbs. when ready for the machine shop. Evidently the common link-and-pin coupling, to which a few people are still so ardently attached, is not entirely without expense either in first cost or cost of maintenance.

AN OIL-BOX GRINDING MACHINE.

One of the most useful new tools at Altoona, is a machine for grinding journal box lids and lid seats. The accompanying cut gives a perspective view of the machine made from a photograph. The machine is the invention of Mr. GILBERT MCCULLOUGH, who has been for a long time in the employ of the Pennsylvania, and Mr. G. W. STRATTAN, Master Mechanic of the Altoona locomotive shops. The important feature of the machine lies in the form in which the emery is used. Instead of using a rotating emery disk, as is ordinarily done in grinding plane surfaces, three cylinders of emery 1¼ ins. in diameter, and about 8 ins. long, are set in a revolving chuck, and held in place by a set-screw. The emery used in this form is found to cut much more freely, while the heating, which made it impossible to use the solid ring of emery at first tried, is almost entirely obviated. The emery cylinders are set out as they wear off, and can be used up with very little waste. They cost at present 22 cents each.

Of course, there is none of the danger of bursting which exists with the solid emery wheel. The machine is driven by two 4-in. belts and short belts lead to the pulleys beneath which drive the feed for traversing the work. The feed gear is all inclosed to protect it from emery dust. This machine will finish about a dozen boxes and lids per hour. The total cost of grinding the lid and lid-seat with this machine is 3 cents. By the method formerly in use here the cost of finishing box and lid was 26 cents. The machine is quite compact, occupying a floor space 2×7 ft., and standing 3 ft. high over all. If making a ground joint between the oil-box lid and its seat will help to keep dust out of the box, it will certainly pay to make it when it can be done so cheaply by this machine.



Machine for Grinding Journal-Box Lids and Lid Seats.

The machine was only patented last November, but several are already in use, including three at Altoona, one in the Pennsylvania shops at Ft. Wayne, one at Columbus and one at the Lehigh Valley shops at Easton. It is now being put on the market by the Springfield Emery Wheel Manufacturing Co., of Springfield Mass.

STEAM CAR HEATING EXPERIMENTS.

A great deal of interest is felt concerning the work the Pennsylvania is doing in car heating, and several times the report has been published that steam heat has been "adopted" for the Pennsylvania system. The officers state, however, that the work they are doing is still experimental, although it is on a scale much larger than experimental operations are generally conducted. About 100 cars in all are now equipped for steam heat on a system quite different from that in use by any other company. It is a return system using a vacuum pump on the locomotive to draw the steam and condensed water through the return pipe. The exhaust from this pump is generally sufficient to heat the train, but it can be supplemented by live steam if necessary. With this pump a vacuum of 15 ins. of mercury or over has been secured at the rear of a train of 12 cars in zero weather. To secure this result it is needless to say the couplings must be perfectly tight. This, however, is easier to secure in the return system than in a direct system, since th temperature is lower. The coupling is made against a ring of vulcabeston, which can be replaced in a minute or two when worn. Rubber hose is used between the cars, but it gives no trouble with the moderate pressures and temperatures, and is so arranged that the sag is only 2 in. between cars. The piping of the system is so arranged that any car can be cut out without interfering with the heating of the rest of the train, and any car can take as much or little steam as desired from the train pipe. This is a feature which some designers of car-heating systems have neglected, but it is one which is very necessary to be secured on the Pennsylvania with its large proportion of long trains.

RELATIONS BETWEEN THE COMPANY AND ITS EMPLOYEES.

In these days when strikes and labor disturbances are rife everywhere, it is pleasing to know of the cordial relations which are maintained between the company and its thousands of employés in the Altoona shops. This is due more than anything else, perhaps, to the plan of considering every man in every grade as in the line of promotion, and treating them as men and not as machines. In this way every man is made to realize that his success depends on himself, and that his honest and intelligent work will meet with reward. I found this expectation of promotion a prominent idea in the minds of several workmen with whom I conversed. In shop work, too, it is not demanded of a workman that he shall do a thing in just such a way, if he can show that his own method is as good or better. Originality is encouraged instead of being repressed, as is often the case, and the result is not only that the men are better contented and take much greater interest in their work, but from time to time new devices and methods are originated of considerable value. This method of treatment of the men, rightly followed, is not at all opposed to the maintenance of discipline. The proper discipline of an industrial establishment is as different a matter as can be from the discipline of a troop of soldiers. The attempt, often made, to apply military discipline to employés is pretty sure to result in failure in the end.

I can mention but two instances of the care of the company for its workmen's comfort and enjoyment. The workmen in the foundry, where the smoke and dirt are worst, have plunge baths provided for their use, so that they can go home at night cleaner even than the workers in the machine shops if they choose. The Altoona mechanics' library is a move toward at once educating and interesting the employés. Any one can join on payment of a small fee, and it is intended to make it as complete a reference library, as regards railway and mechanical matters, as any in the world.

(TO BE CONTINUED.)

CORRESPONDENCE.

The Proposed Missouri Highway Bridge Law.

KANSAS CITY, MO., April 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: On reading your editorial comments on the proposed Missouri highway bridge law, in issue of April 19, wil you permit me respectfully to call more particular attention to Secs. 8, 10 and 13 of this law, which seem to have escaped proper notice.

The primary purpose of its originators was not that the law should operate chiefly in the interest of engineers; but a compensation up to 5 per cent., as specified in Sec. 10, for new work, will, I think, by bridge engineers generally be considered adequate. It is presumed that the greater part of the experts' services would be on new work. The $25 per day applies only to examination of old bridges. A still hunt to any considerable extent for this class of work would be balked by provision in last clause, Sec. 8, for bond and penalties.

Proper constitution ofthe corps of experts was found to be one of the most difficult things to provide for, from the fact that there is no generally recognized authority on qualification. Some of the experts might be regular employés of bridge contractors. Sec. 13, however, guards against the acceptance of any bridge by an expert who is

in the employ of a contractor for it, or is in any way financially interested in the contract.

Let me add that the framers of the proposed law are far from considering it perfect, and will be glad to note and act on any suggestions giving any feasible improvements on it W. H. B.

Bridge Accidents and New York Railway Accidents.

ALBANY, N. Y., April 21, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In regard to the comparisons in your last issue on the figures given in Mr. THEODORE COOPER'S recent paper, permit me to give you a pointer on the accuracy of your basis.

The number of miles of road given in first three items of Mr. COOPER'S Table No. 3 (p. 44 of July *Transactions* of AM. SOC. C. E.) are:

	Miles.
N. Y. Central and West Shore	2,894
N. Y., L. E. & W. R. R.	1,514
Other roads in New York	3,586

The first two have been reduced to single track basis, hence it is fair (and is inferred in context) that the third is likewise.

The correct figures are as follows:

	In N. Y.	Out of N. Y.	Total.
N. Y. C. & West Shore	2,890	49	2,939
N. Y., L. E. & W.	1,230	326	1,546

	Miles.
Total main line and additional tracks in New York State, exclusive of sidings and turnouts	9,977
Deduct for Central and Erie	4,110
Leaving for other roads	5,867
Same by Cooper's table	3,586
Difference	2,281

Error $= \frac{2,281}{3,586} = 63$ per cent., nearly on this one item.

If the rest of Mr. COOPER'S figures are equally reliable, the value of statistics based upon same is evident.

CHAS. F. STOWELL.

[While it is proper that errors of this kind, if they exist, should be pointed out, the one noted would not greatly affect the particular use which we made of these statistics. As we stated, they seem to us open to some question in respect to the proportion of iron to wooden bridges; but they are the best and only available evidence on that point that we know of.—EDS. ENG. NEWS.]

The Baldwin Compound Locomotive.

(WITH INSET.)

Through the courtesy of Messrs. Burnham, Parry, Williams & Co., we are enabled to present upon our inset sheet this week drawings of the new compound locomotive, built by the Baldwin Locomotive Works for fast passenger service on the Baltimore & Ohio R. R. Notes of this locomotive, which is the first 4-cylinder compound to be built in America, have been given from time to time in this journal, and the detailed drawings showing its construction, with the indicator diagrams showing its performance will, we feel sure, be examined with much interest.

It is undeniable that there is no small amount of prejudice against a 3-cylinder or 4-cylinder locomotive. It seems to be thought that the multiplication of cylinders must necessitate a corresponding multiplication of parts and complication, involving greater liability to failures in service and increased expense for repairs. But it is at least worth while when an establishment with the reputation of the Baldwin Works designs a 4-cylinder compound and gives it its commendation, to give the machine a careful examination, and see whether the supposed additional complication, cost and liability to derangement actually exists.

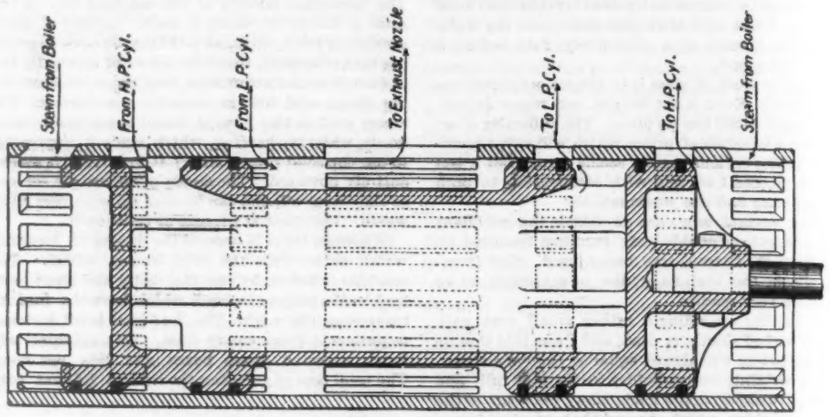
The only parts of the Baldwin compound locomotive, which differ from an ordinary locomotive are the cylinders, valve and crosshead attachments, a perspective view of which is shown herewith. The locomotive is of the ordinary 8-wheel American type, weighing 105,480 lbs., with a total wheel base of 21 ft. 11 ins. Other dimensions of the engine are as follows:

High-pressure cylinder	12 ins. × 24 ins.
Low-pressure cylinder	20 ins. × 24 ins.
Diameter of drivers	66 ins.
Weight on "	75,515 lbs.
" " truck	33,965 lbs.
Driving wheel base	7 ft. 6 ins.
Truck wheel base	6 ft.
Total wheel base	21 ft. 11 ins.
Fire-box	length, 107⅛ in.; width, 33⅝ ins.
Fire-box	depth, front, 63¼ ins.; back, 48¼ ins.
251 tubes	2 ins. diam, 11 ft. 10 ins. long.
Boiler diameter at smallest ring	58 ins.
" height of centre above rail	7 ft. 4¼ ins.
Capacity of tank	3,500 galls.

The details of construction of the locomotive are clearly shown upon the drawings and in the perspective view. As will be seen, the high-pressure cylinder is set vertically over the low-pressure cylinder, and both are connected to a common crosshead. It is a common idea that a 4-cylinder locomotive must have a valve for each cylinder, and hence at least twice the number of parts and complexity in its valve motion of a common locomotive. But in the engine illustrated a single piston valve controls the steam supply for the two cylinders, and seems to combine in a remarkable degree simplicity and effectiveness. Large scale working drawings of the valve and its bushings are shown on our inset sheet, but the accompanying diagram, Fig. 2, in which the valve-cylinder, bushing and valve are shown together, will make clear the distribution of the steam. The valve is described by its designer as composed of two ordinary slide valves, one within the other, the outer one controlling the steam port of the high-pressure cylinder, the inner one controlling the steam port of the low-pressure cylinder. The bushing is fitted to the valve cylinder, so that the ports come opposite the steam passages cored in the castings. As seen by the cross-section of the bushing, each port is divided by narrow bridges into 19 inch-wide openings. The live steam ports at each end have a width of 2 ins. The ports to the cylinders each have a width of 1⅛ ins., and the exhaust port has a width of 6 ins. It will be seen that the very long ports, which are easily secured with the cylindrical valve seat, provide a larger steam passage than can be conveniently got with a plane valve. With the same travel of valve the liability to throttling at the port openings is thus lessened. It will be seen that if it should be found advisable, the length of the steam ports can be considerably increased by narrowing the width of the bridges.

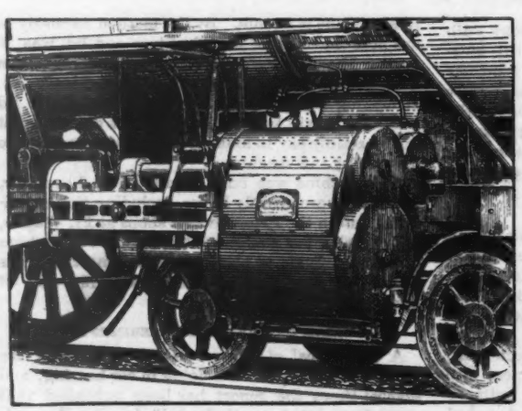
By no means the least of the virtues of this valve are, that it is by its construction perfectly balanced, and no possible leakage of steam can make it wear the bushing unevenly. This is a great advantage over the plain slide valve, and the same end is secured which is gained in the best balanced valves, with much simpler mechanism. Any combination desired in the valve can be made as easily as in the plain slide valve. The makers state that the simplicity of the valve, and the absence of the usual rock-shaft, make the valve mechanism cheaper in first cost than that on an ordinary locomotive, and at the same time far more durable.

The outward connections of the valve mechanism are shown on our inset sheet. It will be seen that the link block has an arm attached, passing up and outward, and connecting directly to the valve rod. A bar attached, sliding in guides insures a true rectilinear motion to the valve rod. This mechanism certainly appears to be a simple and durable one. It is to be remembered that the only resistance to the motion of the piston is that due to the friction of its packing rings, and the work and wear of the valve motion could be correspondingly light.



Cylindrical Valve and Bushing; Baldwin Compound Locomotive, Vertical Longitudinal Section.

One of the most novel features of the engine is the arrangement for starting. In most compound engines thus far built some device has been introduced for working steam direct from the boiler in both cylinders at the start, and in order to do this complications in the valve motion have been necessary. In the engine illustrated the expedient is adopted of letting the low-pressure cylinders alone start the train whenever the load is such that it does not readily start with the engines working compound. The device is illustrated on our inset sheet. A pipe connects the two ends of the high-pressure cylinder, but is ordinarily kept closed by cocks at its ends. When the train is to be started these cocks are opened by a rod running to the cab, and the steam from the boiler passes through this pipe to the exhaust side, and thence to the low-pressure cylinder the high-pressure cylinder thus acting for the moment simply as a steam pipe.



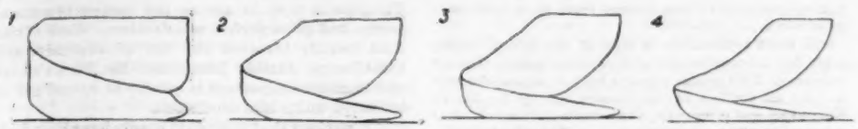
The Baldwin Compound Locomotive. View from a Photograph, Showing Cylinders and Connections.

As the low-pressure cylinders are 20 ins. in diameter they are quite capable alone, with steam at 160 lbs. pressure, of starting a train as heavy as the adhesion of the drivers will permit.

The arrangement of guides on the engine is fully shown by the perspective view and on the inset sheet. The crosshead carries two lugs to which the piston rods are attached. Judging by the indicator diagrams, the work done by the two pistons is about equal, and the crosshead is therefore set midway between the piston rods. The only time when an especially heavy strain comes upon the crosshead and guides is when the low-pressure cylinder is working alone at starting, but for a few revolutions at slow speed the mechanism is probably well able to take this strain. The makers say: "In the connection of two pistons to a common crosshead the most satisfactory results have ensued. The guide-bars and guide-bearer are very light, and no heating, cutting or bending has been noticeable in some 30,000 miles of service. A spoonful of oil is sufficient to lubricate them during a run of 100 miles."

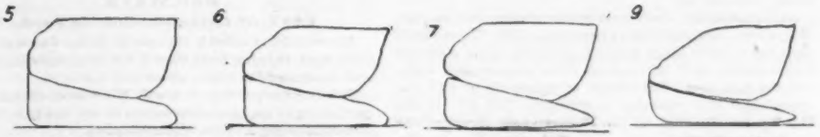
Concerning other details and its performance in service the makers write us as follows:

Water caused by condensation in cylinders, the enemy



Full st oke. 15" cut-off. 12" cut-off. 9" cut-off.

Cards 1 to 4.—*Ideal Diagrams from which the engine was designed.*

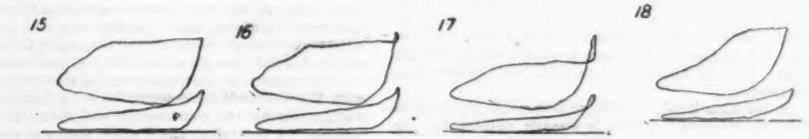


	Starting heavy train.	Train of 20 fr't cars.	Steam, 160 lbs.	Steam, 150 lbs.
Cut-off.....	20"	18"	20"	14"
Speed, m. p. h.	11	15	29	31
Revs.....	54	75	96	136
Total H. P....	354	468	568	747

Cards 5, 6, 7. 9.—*Various service diagrams.*

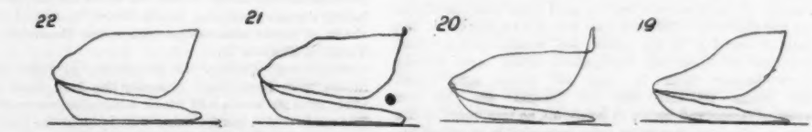
Cut-off.....	9"	15"	17"	15"
Speed, m. h. p.	30	37	44	47
Revs.....	150	183	218	234
Total H. P....	607	826	837	908

Cards 8, 10, 11, 12.—*Service diagrams, steam throttled.*

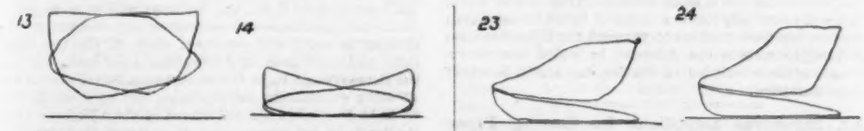


Cut-off.....	15"	15"	17"	9"
Speed, m. p. h...	41	48	60	37
Revs.....	204	240	300	186
Total H. P.....	814	835	753	479

Cards 15 to 18.—*Taken from front ends of both cylinders to show simultaneous effect on both cylinders.*



Cards 19 to 24.—*Reverse of the above cards, 15 to 18, showing continuous expansion.*
[These are identical with the above, except that the low-pressure diagram is reversed.]



	High-pressure cylinder, M. E. P., 91 and 91.	Low-pressure cylinder, M. E. P., 41 and 40.8.
Cut-off.	12"	10"
Speed, m. p. h..	37	14
Revs.....	186	70
Total H. P.	586	254

Cards 13-14.—*Taken to show how the valve was divided.*

Cards 23-24.—*Samples of short cut-off cards.*

Card No.	Revolutions per minute.	Miles per hour.	Cut-off H. P. cylinder.	M. E. P. H. P. cylinder.	M. E. P. L. P. cylinder.	Total H. P. developed.	Remarks.
1							Cards Nos. 1, 2, 3, 4 are the ideal cards from which engine was designed. H. P. Cyl. 12 in. diam. L. P. Cyl. 20 in. diam.
2			15"				
3			12"				
4			9"				
5	54	11	20"	100	50	353.8	Starting heavy train.
6	75	15	18"	81	50	468.5	Train of 20 freight cars.
7	96	20	20"	94	47	568	Steam, 160 lbs. pressure.
8	150	30	9"	58	24.5	607.2	Throttled.
9	136	31	14"	83	33	747	Steam, 150 lbs. pressure.
10	183	37	15"	73	33	826.3	Throttled.
11	218	44	17"	65	27	836.7	Throttled.
12	234	47	15"	66.5	27	907.8	Throttled.
13				91 x 91			Taken to show how the valve was divided.
14					41 x 40.8		
15	204	41	15"	76.5	27	813.8	Cards were taken from front ends of both cylinders to show simultaneous effect on both pistons.
16	240	48	15"	63	23	834.9	
17	300	60	17"	47	16	753.2	
18	186	37	9"	53.5	18.5	479.18	
19							These are the reverse of the above cards and show the continuous expansion.
20							
21							
22							
23	186	37	12"	53	22	586.2	Sample of short cut-off cards.
24	70	14	10"	60	26	253.7	

INDICATOR DIAGRAMS, BALDWIN COMPOUND LOCOMOTIVE.

of compound locomotives in general, is felt to a very slight extent only, so little that no cylinder cocks are required for the high-pressure cylinders, and one or two strokes entirely clears the low-pressure cylinders. Relief valves are provided on the low-pressure cylinders to prevent damage in case a careless engineer should get the boiler too full of water and work it over into the cylinders.

The two extra pistons required over the ordinary locomotive are small and comparatively inexpensive. The stuffing boxes, being fitted with metallic packing, are not serious matters either in first cost or maintenance. The casting comprising the cylinders, steam chest and half saddle, is of about the same weight as that used in the ordinary locomotive, the exact weight on the truck of this engine being but 25 lbs. more than in the ordinary locomotive of the same size. This is, of course, phenomenal, and the variation one way or the other may be several pounds.

An inspection of the indicator diagrams will show that the steam is used with great economy. The extreme shortness of the steam passages, together with ample exhaust passages, precludes the possibility of the results shown by any other method than direct expansion, absence of an intermediate receiver, and the use of the piston valve. Heavy freight trains as well as fast express trains have been hauled with equal success. A piston speed of 1,500 ft. per minute has been attained in express service.

As this locomotive has been developed and improved during the past six months, the Baldwin Locomotive Works are now in position to proceed with accurate tests. Comparison will be made between the compound and the ordinary locomotive of the same class, built alike in all other respects. With the engine now running the economy is so apparent that it is expected the tests will show at least 25 per cent. less fuel used than in the ordinary locomotive, and little if any more expense for repairs. The special features of this engine are covered by patents Nos. 406,011, 406,012, and others pending.

The accompanying indicator diagrams, with the table of data, show certainly an extremely good performance, and the Baldwin Locomotive Works are to be congratulated on its success. An especially good feature is the small amount of back pressure. There may be room for improvement, however, in getting the steam into the cylinders with even less throttling, although the throttling already remarkably small. We see no objection to lengthening by several inches the steam ports, and narrowing the bridges, and it is pretty certain that the change would give considerable improvement in the cards taken at high speeds and short cut-offs. The valve now has 9 ins. of bearing surface at the ports, and it seems certain that this could be reduced very considerably without causing undue wear. This excellent feature of the piston valve, in permitting the use of extremely long ports, is one which deserves more consideration than it generally receives. Throttling the steam in the ports is an admitted inherent defect of the Stephenson valve gear; but it is one which can be largely remedied by the use of very long ports.

The only other point in which the locomotive seems open to criticism is in the increased weight of counterbalance necessary to offset the additions to the weight of reciprocating parts.

We are not informed as to the exact weight of the reciprocating parts in this locomotive, but it is from 30 to 50 per cent. increase over the simple locomotive. This will require, according to present practice, a considerable addition to the counterbalance weights, and will thus increase the "hammer blow" of the engine to quite an extent. There is no doubt that the serious nature of this "hammer blow" action of the locomotive has been unduly magnified by some engineers. Still, it is a matter which deserves attention in this connection, especially since compound locomotives are especially commended for use at high speeds.

An increase in weight of the reciprocating parts is necessary in any type of the compound locomotive, and a two-cylinder locomotive will have as much increase in piston area as a four-cylinder locomotive of the same power. But as a practical matter, although we have not the actual weights at hand, we should expect the reciprocating parts in this locomotive to weigh perhaps 10 to 20 per cent. more than in a two-cylinder compound of the same power, and perhaps 40 per cent. more than in an ordinary type locomotive.

The importance of this matter, however, while undeniable, is only one element, in deciding the relative merits of the four cylinder and the two-cylinder compound. The makers of this locomotive state that it operates with remarkable smoothness, and at speeds of over 60 miles per hour she is said to ride very comfortably. She might do this

however, and still give a pretty heavy pressure on the rail as her counterweights came down, the hammer blow having no direct effect on the riding qualities of the locomotive.

But if it is found that this increased hammer-blow is too serious a matter to neglect, we trust that the Baldwin Works will show as much ability in designing a set of light pistons for this engine as they have shown in the design of the engine. It can scarcely be denied that the reciprocating parts of a common locomotive could be considerably lightened by substituting stronger metals for cast iron, as is done now in England, and is not done here because for various reasons it is not thought worth while.

The increased cost of building this locomotive over the common locomotive cannot be any considerable sum. The cylinder casting weighs no more, though it is a little more complicated. The crosshead costs, probably, about twice as much as a common crosshead. The high-pressure cylinders and piston, with their fittings and the starting valve, are extra, and the valve and valve gear costs a little less. Other parts are unchanged from the ordinary locomotive. In repairing the only extra cost is the reboring of the 12-in. cylinder and whatever work may be required on its piston, rod, and stuffing-box. Wear on the valve should be very small, and the renewal of the rings at long intervals and of the bushing should keep it perfectly tight at slight expense.

Certainly with this showing even the poorest roads and those who buy their fuel at lowest prices, need not fear to try compounding. The economy secured by expanding steam through two cylinders is well known, and only the supposed extra expense of first cost and repairs and difficulties in working have delayed application of the principle to locomotives. With the real facts thus plainly stated it seems certain that experiments with the compound locomotive will no longer be confined to Eastern roads, which can buy fuel at low prices. The many railways on this continent which have to pay $5.00 a ton and upward for locomotive fuel will make haste to realize the certain economy due to compounding, and when its introduction once begins, the change from the simple type will be a very rapid one.

The Warm Winter Weather of 1889 and 1890.*

The entire three months of the calendar winter of 1889–90 having passed with such absence of the ordinary conditions as to amount almost to a calamity, it is worth while to inquire what law or line of precedents may enable us to define the succession of extreme conditions in either direction, and to anticipate or prepare for such extremes.

There are few places at which thermometric observations have been taken continuously under the same general conditions more than 50 or 60 years, yet by connecting results at places not far apart, we may get a fair comparison for about 100 years. This can be done at Philadelphia quite completely from 1790, and with a few interruptions back to 1758. In and near New York we get less of early observations, but at Boston, including Salem and other towns, we have fairly comparable series from 1742.

The New England climate is 5° warmer for the mean of the winter than that of Philadelphia, and the mountainous districts of Northern Pennsylvania are from 3° to 5° colder still for the mean of the winter months. But the differences of extreme months from the fixed mean are nearly the same, that is, an extremely cold month may be 15° to 18° below the mean, and an extremely warm month may be 10° to 12° above the constant or fixed mean for a long period.

The present winter began with December at 43¼°, which is 9° above the normal, or permanent mean, at Philadelphia. It was relatively warmer in Northern Pennsylvania, where the excess was 10°, and in most of the western interior the mean was 15° to 18° above the normal. The U. S. Signal Service report characterizes it as the warmest December known to their records, those of 1877 and 1881 being the only instances approaching it; very little snow fell, and no ice of consequence was formed even in New England.

January of 1890 continued almost equally warm throughout the month, and generally 9° to 10° above the normal, the entire country east of the Rocky Mountains being alike as was also the case in December. There was heavy snow on the Sierras, but very little in any of the States eastward. The rivers were not frozen, nor was there ice enough in Maine for commercial storage. Much surprise was felt at the long succession of mild winter weather, and but two or three instances appear in the history of temperature observations in which two entire winter months have been exempt from snow and ice as these were.

Still more remarkable in view of the record already made was the continuance of high temperatures through February. This month was also fully 10° above the normal for all portions of the country east of the Rocky Mountains, and it was also characterized by much clear and calm weather. On three or four days the temperature rose to 65°, and once to 70° in Philadelphia, many buds expanded, and woodland flowers appeared. In the Southern States spring weather was at its best, and many crops were put in.

At Philadelphia, there is no winter similar to this since 1780 at least, and apparently none since 1748. There have been some warm single months, and very rarely a second warm month, but in no case three consecutive warm months until now. The month of February in 1775 was exceptional, 46.2°; and that of January, 1790, 44°. In the 65 full years observed at the Pennsylvania Hospital, the single maxima are January, 41.1°; February, 42°; and December, 43.2°; this last in 1848. But in no part of the series are there two winter months together that average exceptionally warm. The winter of 1879–80 was quite uniformly warm, but its average was below 40°, and 2° on each month below the present winter.

The freezing of rivers is a good general standard in cold climates. The Hudson River remained unfrozen through the present winter, and no other instance like it has been known since Europeans came here. From 1790 to 1852 the average date of the close of navigation at Albany by ice was Dec. 17.

In Russia an interesting proof of the permanence of the climate is afforded in the record of the date of the breaking up of the great river Dwina by ice, such record having been kept for more than 300 years, 1530 to 1852. The mean of these dates for the entire period was March 26, and dividing the record in periods of 50 years, the dates differ one or two days only. In periods of 100 years the date is March 26, with a fraction, in each case. I published these records in full in 1857, as taken from Kuppfer's *Annales du Obs. Physique Central de Russie.* More extended analyses made at that time than I could cite here, satisfied me that the climate of the North temperate latitudes, both in Europe and America, was substantially permanent.

On the other hand, it is alleged in the *Pall Mall Gazette* that the European climate is steadily moderating. In the time of the Roman republic the rivers in Gaul used to freeze over in winter, and Roman writers represent Germany as a land of frozen morasses. Compare the climate at present enjoyed by those countries with this description, and it will be at once apparent how great a change in climate must have gradually taken place. The records of the Hudson's Bay Co. also show that the winter on the shores of Hudson's Bay has grown shorter at the rate of one day in ten years, the season during which the sea is open for navigation being now twenty days longer than it was 200 years ago. About the years 1815–1818 the ice barrier on the east coast of Greenland began to break up, as was noted at the time by Sir JOHN BARROW, who regarded it as one of the most important, though least noticed, events in the history of the world. All this is regarded as evidence that the ice barrier is being steadily driven further north, and will eventually leave a channel by which the Japan current can flow unchecked through the Polar Sea from Behring's Straits to the Atlantic, in which case the existence of the remainder of the ice cap might be but of short duration.

* By Prof. LORIN BLODGET, in the *Colliery Engineer.*

An Ingenious Expedient for Laying Pipes Under Water.

Mr. F. S. PECKE, a civil engineer at Watertown, N. Y., lately accomplished in a very simple, cheap and expeditious way what is usually a difficult and expensive operation—the laying of a long line of pipe in deep water. He had occasion to lay nearly 1,000 ft. of suction pipe at Rouse's Point. The water was needed for manufacturing purposes, and as it was found that water near the shore was more or less roily and impure, it was necessary to place the inlet a considerable distance out in the lake. He purchased for the purpose a steel pressure pipe of 8 ins. diam., manufactured by the Spiral Weld Tube Co., at East Orange, N. J., and used for couplings cast-iron flanges, weighing, with bolts and gaskets, about 65 lbs. to the pair. Plugging the end of the first length, he pushed it out on the surface of Lake Champlain and connected the second length; pushing this out in turn, until the whole line was coupled. It then presented the unusual spectacle of a line of 8-in. pressure pipe nearly a thousand feet long, floating with a displacement of only 3½ ins. of its diameter. When the requisite length had been connected the line was towed to position, the plug at the end removed, and the pipe sank easily in 16½ ft. of water without breaking a joint or receiving any injury. No buoys or floats were used in the operation, and no apparatus of any kind. The pipe is now in use as the suction of a steam pump, and gives perfect satisfaction. Work of this kind usually involves the use of expensive and troublesome flexible joints, and Mr. PECKE's neat and ingenious expedient is worthy of record and of imitation under like conditions.

It is obvious that this could hardly have been done with cast-iron pipe on account of its rigidity and liability to fracture.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Keeseville, Au Sable Chasm & Lake Champlain.—This road, running from Port Kent to Keeseville, N. Y., will be opened for traffic about May 15.

Toledo, Ann Arbor & North Michigan.—Work is reported begun on the construction of the line from Mount Pleasant to Big Rapids, Mich., 40 miles.

Cleveland, Cincinnati, Chicago & St. Louis.—Reports are in circulation that this company intends to construct a line into Chicago during the coming season. Two lines are under consideration; from St. Mary's, Ill., north, 66 miles, and from St. Anne, north, 60 miles. The company now leases the tracks of the Illinois Central R. R., from Kankakee to Chicago.

Kanona & Prattsbury.—This company has under consideration the extension of its line from Prattsburg, N. Y., north, to Geneva, N. Y.

Cleveland, Akron & Western.—This company has let the contract for the construction of its line between Akron and Corey, O., to Creech & Lee, of Harrington, Kan. Work is to be commenced at once, and the line completed this year.

Canadian Pacific.—The ninth annual meeting of the stockholders of this company will be held May 14 to elect directors and for the following purposes: To provide for the issue to a limited amount of bonds in aid of the acquisition of steam vessels, under the Dominion Act, 52 Victoria, Chap. 73, and for securing such issue according to the provisions of that act. To authorize and ratify an agreement with the Shuswap and Okanagan Railway Co. concerning the leasing and operation of that Company's Ry. To authorize such arrangements by lease or otherwise with the Columbia & Kootenay Ry. & Navigation Co. as will provide for the construction and operation by this company of the railway and other works of that company. To provide for the construction and equipment of the Souris branch of the company's railway (which branch is to include extensions in Southern Manitoba and to the West thereof), and for the issue of bonds in aid thereof, and for securing such issue. To provide for the issue of Consolidated Debenture Stock for the purpose of satisfying or acquiring bonds issued in aid of the purchase of ocean steamships under the Dominion Act, 52 Victoria, Chapter 73.

Allegheny Valley.—It is announced that arrangements have been made whereby the long legal controversy over its bonds will reach a satisfactory settlement. The road, which has for some time been in the hands of a receiver, is to be allowed to go to sale under the proceedings instituted in the United States Court by the holders of the 7 per cent. income bonds. It will be bought in by the Pennsylvania R. R., the company will be recognized, the 7 per cent. income bondholders' claims taken up, including interest, with preferred stock in the new company, and a new loan of $20,000,000 at 4 per cent., bearing the Pennsylvania R. R. Co.'s guarantee, issued to take up all other outstanding indebtedness, leaving about $4,000,000 to be devoted to the betterment of the Allegheny Valley Road and its connections. It is stated that this proposition has received the approval of the Pennsylvania R. R. Co. Directory, and would be accepted by the syndicate here representing about $3,000,000 of the 7 per cent. income.

Dutchess County.—The contract for building this road mentioned last week, has been let to Andrews & Warner, of 202 Broadway, New York City. The work is to be finished this season.

Lehigh Valley.—A press dispatch says:

A meeting of the Lehigh Valley and Pennsylvania R. R. officials will be held at Bethlehem, Pa., Wednesday, to consider the plans of the engineers who have been surveying lines for the extension of the Lehigh Valley road to Philadelphia. The route most favored leaves the main line of the Lehigh Valley at Freemansburg, two or three miles east of Bethlehem, and, running south, passes near Applebachsville, Bucks County, crosses the North Pennsylvania R. R. at Rockhill Station, touches Harleysville, in Montgomery County, and makes connection at Conshohocken with the tracks of the Schuylkill Valley branch of the Pennsylvania R. R., by which an entrance into Broad St. Station would be secured. This line would be 57.5 miles long, against 56 miles for the North Pennsylvania road.

Old Colony.—The Massachusetts Railroad Commissioners have decided in the favor of this road in the matter of the rival petitions between it and the New York & New England R. R., for permission to construct a branch loop road from Norwood to Walpole, Mass.

Lehigh Valley.—The contracts for the construction of the Buffalo & Geneva R. R., have been awarded as follows: J. C. Rodgers, of New York City, sections 1 to 10; Ward & Leary, Newburgh, N.Y., sections 11 to 20; Dick & Mantz, Hazleton, Pa., sections 21 to 30; Wm. R. Harris & Co., Buffalo, N. Y., sections 31 to 40; Brodhead & Hick-

ley, New Ringgold, Pa., sections 41 to 55; Dowling & Kennedy, Binghamton, N. Y., sections 56 to 70; J. K. Fisher, Harrisburg, Pa., sections 70 to 93.

Projects and Surveys.

Phillips & Rangeley.—At a meeting of the directors recently held, a committee consisting of Weston Lewis, of Gorham, Me.; G. M. Gardiner, of Haverhill, Me., and W. A. Rich, of Medford, Me., were chosen to make the necessary arrangements, and let the contracts for the construction of this road. A meeting of the stockholders will be held soon to consider the question of increasing the capital stock of the company to $100,000. The route is projected to run from Phillips to Rangeley, Me., 27 miles. F. E. Timberlake, of Phillips, Me., is Secretary.

Newburg & Walden.—Arrangements are said to be nearly completed for the construction of a railway from Newburg to Walden, N. Y., a distance of about 10 miles.

New York & Ohio.—This for some time dormant project, to build a railway from a point near Hudson, O., east to a point on the Pennsylvania State line in Trumbell Co., has been revived, and a mortgage for $1,000,000 to the Farmers' Loan and Trust Co., of New York City, is being filed in the various counties along the route. The company will issue bonds at the rate of $20,000 per mile on the main line and extensions, the proceeds to be used in the construction of the road. The line has been surveyed, and a considerable amount of grading was partly completed in 1888, since that time nothing has been done. D. M. Yeomans, of 35 Wall St., New York City, is president.

Ellwood Short Line.—Incorporated in Pennsylvania to build a railway from a point north of Sewickley Station to Rock Point station, a distance of 4 miles, all in the counties of Beaver and Lawrence. The principal office of the company will be at Beaver Falls, Pa. Henry W. Hardman, of Beaver Falls, is interested.

Canada.—The Governor-General has given the Royal assent to the following bills: To incorporate the Manitoba & Southeastern Ry. Co., the Owen Sound & Lake Huron Ry. Co., the Interprovincial Bridge Co., the North Canadian Atlantic Railway and Steamship Co., and the Montreal Bridge Co. Also to an act to amend an act to incorporate the River Detroit Winter Railway Bridge Co., and to change the name of the company to the River Detroit Railway Bridge Co., and to an act changing the name of the Napanee, Tamworth & Quebec Ry. Co. to the Kingston, Napanee & Western Ry. Co.

New Albany Belt & Terminal.—Surveys are in progress under the direction of John McLeod, Chief Engineer, for the proposed belt line railway at New Albany, Ind. The object of the road is to furnish a freight line transfer for the various railways entering the city.

Toronto, Hamilton & Buffalo.—E. B. Wingate, of Hamilton, Ont., Chief Engineer, has furnished us the following information concerning this road:

The road is projected to run from Welland, Ont., to Hamilton, Ont., 39 miles, and from Hamilton to Toronto, Ont., 38½ miles, a total of 77½ miles. The locating surveys have been practically completed, only a few slight changes remaining to be made. The work will be generally heavy; maximum curve 8 deg. and maximum grade 1 per cent. There will be 10 bridges on the line from 300 ft. to 600 ft. long, 20 ft. to 95 ft. high, and with spans of from 45 ft. to 153 ft. long. There will be two double track tunnels in the city of Hamilton. One of these will be 1,320 ft. long and from 25 ft. to 32 ft. below the surface, passing under the principal streets of the city. The other will pass under the city cemetery, and will be 1,000 ft. long and 80 ft. below the surface. Negotiations are now in progress for the right of way. The city of Hamilton has voted $275,000 in aid of the enterprise, and other aid from the Provincial Government and the towns along the route has been promised. The time of commencing construction has not been definitely decided upon yet, but will be commenced soon as the lines from Waterford to Hamilton, 26 miles, and from Welland to Hamilton must be completed by Nov. 1, 1891, in order to earn the $275,000 voted by the latter place. The line from Waterford to Hamilton is being built under the name of the Brantford, Waterloo & Lake Erie Ry., which will be consolidated with the Toronto, Hamilton & Buffalo Ry. when completed. Both lines are being built and are owned by James N. Young & Co., of Chicago, Ill. The president of the T., H. & B. R.R. is Alonzo Stephens, of 164 Dearborn St., Chicago.

Kinzua Valley.—J. C. French, of Olean, N. Y., sends us the following information concerning this enterprise:

The road is projected to run from Riderville, Pa., via Tally-ho and South Fork, to Morrisons, Pa., a distance of 21 miles. The surveys have all been completed, and about 2 miles of the line built. Construction is now in progress. The work is generally quite heavy. The principal business of the road will be in lumber and oil well supplies. The officers of the road are: President, S. S. Bullis, of Olean, N. Y., and W. B. Parsons, of New York City.

Dayton, Hocking Valley & Eastern.—Chartered in Ohio to build a line of railway from Dayton to Marietta, O. Among the incorporators are: Frank T. Hoffman, Chas. E. Drury and J. K. McIntire, all of Dayton, O.

SOUTHERN.—Existing Roads.

Wilmington, Onslow & East Carolina.—F. L. Pitman, of Wilmington, N. C., Chief Engineer, writes as follows concerning the division from Wilmington to Jacksonville:

The entire 50 miles of the line have been graded and 9 miles of the track laid. About 125 men are now at work tracklaying and surfacing. It is expected to have the line completed and opened for traffic by July, 1890. The route is through a nearly level, timbered country affording very easy work; maximum grade, 1 per cent., and maximum curve 2°. There is one 600-ft. pile trestle, with a 30-ft. draw span, at New River. The principal business of the road will be in lumber, agricultural produce, turpentine, tar, resin, fish and oysters, and general merchandise. W. B. Goodwyn, of Wilmington, N. C., is the contractor. Geo. M. Brockman, Assistant Engineer, is in charge of the tracklaying.

Atlantic & Danville.—T. Waln-Morgan Draper, of Portsmouth, Va., sends us the following data:

During 1889 track was laid on this road from Edgerton, Va., to Danville, 116.5 miles; from Hodge's Ferry to Portsmouth, 6 miles. The main line was opened for traffic Jan. 20, 1889. Since that time the branch from the main line to Buffalo Lithia Springs, 4 miles, has been completed. Work is now in progress on the Hitchcock branch connecting with the main line at Belfield, Va. The company is now operating 206 miles of main line and 37 miles of branches and sidings, standard gauge, and 55 miles of main line and 8½ miles of branches and sidings, narrow gauge. On May 1 the freight line of the company was extended by car barges from Portsmouth and West Norfolk to Cape Charles, the terminus of the New York, Philadelphia & Norfolk R. R. The Danville & East Tennessee R. R. is now under survey from Danville, Va., west to a point near Bristol, Tenn.

Abbeville & Way Cross.—About 10 miles of the grading on this road have been completed, and tracklaying will begin as soon as the necessary material arrives.

Kanawha & Michigan.—This company has been incorporated in West Virginia to succeed to the property and railway which formerly belonged to the Kanawha & Ohio Ry. Co. The incorporators are Nelson Robinson and William B. Post of New York, and C. P. L. Butler, Jr., G. C. Hoover and George Hardy, of Columbus, O. The capital stock is $10,000,000, divided into 100,000 shares of $100 each. The members composing the first Board of Directors will be R. W. Kelley of New York, E. J. Jones and Henry L. Woodward of Athens, David W. Patterson, Jr., and Frank Cox of Charleston, West Va. The railway at present is about 150 miles in length, and extends from the village of Corning, in Perry Co., to Charleston, W. Va., crossing the Ohio River at Point Pleasant, and is now being constructed southeasterly from Charleston to a junction point with the Chesapeake & Ohio Ry. near the mouth of the Gauley River. This reorganization is the result of a foreclosure suit and the sale of the property a few days ago by P. W. Huntington as Commissioner. A lease will at once be entered into with the Chesapeake & Ohio Ry. Co., which will operate the property, taking possession on May 1.

Knoxville Southern.—One of the contractors on this road is reported as saying that 110 miles of track had been laid from Marietta, Ga., toward Knoxville, Tenn. The remaining 75 miles to Knoxville are all under contract, and a large force is at work grading and bridging. It is expected to have the line completed by August.

Charleston, Sumter & Northern.—The surveys for the extension from Sumter to Bennettsville, S. C., have been completed from Sumter to the Pee Dee River. The grading will be commenced soon, and it is expected that the road will be completed from Bennettsville to the Pee Dee in about eight weeks after the commencement of work. The line from Sumter to the Pee Dee will be longer in building on account of the large amount of trestling.

Norfolk & Western.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$5,597,124
Operating expenses and taxes	3,483,352
Net earnings	$2,113,772

Tavares & Gulf.—This company has been organized to build a railway from Tavares to Punta Gorda, Fla., a distance of 200 miles. The road is already completed from Tavares to Clermont, 25 miles. The directors are: Jas. P. Taliaferro, Daniel G. Ambler, Henry H. Jackson and Charles Tremain.

Wrightsville & Tennile.—A press dispatch states that a resolution of the directors providing for the extension of this Georgia road to Abbeville, Ga., has been filed with the Secretary of State. The extension will be 40 miles long.

Georgia.—King & Bros., of Covington, Va., will sublet the contracts for 35 miles of railway work.

PROJECTS AND SURVEYS.

Birmingham & Shade Mountain.—D. P. Hale, of Oxmoor, Ala., President, has furnished us with the following data concerning this road:

The road is projected to connect the towns of Elyton, Gracis, Barnston and Oxmoor with Hale Springs and Birmingham, Ala. The length of the road will be 10 miles. The work will be generally light, maximum grade 3 per cent. The business of the road will be the freight traffic from the mining towns and the passenger travel to Hale Springs, which is to be made a summer resort. The company will do its own work. Surveys will begin in about 2 months.

Florida, Midland & Georgia.—The engineering corps, under the direction of Chief Engineer Arthur Pou, has completed the survey of this line from the Georgia State line to Deadman's Bay, a distance of 73 miles. Nearly the entire distance is through a wooded country.

Mount Pleasant, Santee & Little River.—J. C. McNoughton, President, of 228 Dock St., Philadelphia, Pa., writes us that this road is to run from Charleston, S. C., via Georgetown and Wilmington to Norfolk, Va., a distance of about 330 miles. The work will be generally light. The principal business will be in lumber, cotton, rice and naval stores. Work is in progress securing local aid.

Chattanooga, Gadsden & Birmingham Air Line.—J. C. Henderson, General Manager, of Chattanooga, Tenn., has turned this enterprise over to a construction company, and the road will be constructed from Eagle Cliff, Ga., to Gadsden, Ala., 84 miles, as soon as possible. The route is along the east side of Lookout Mountain, and passes through a region rich in iron ore, timber and coal. The work will be generally light. There will be one tunnel 1,500 ft. long.

Virginia & North Carolina Construction Co.—This company has been organized with a capital stock of $600,000. The purpose of the company is railway construction in the South. The capital stock is chiefly held in Baltimore by John Gill, W. W. Spence, Enoch Pratt, John A. Hambleton, Thomas Deford, George C. Jenkins, Bernard Cahn, C. W. Slagle, Charles D. Fisher and Andrew Reid.

Alpharetta & Blue Ridge.—It is stated that surveys will soon be commenced on this Georgia road. B. F. Abbott, of Atlanta, Ga., is President.

Kentucky.—Bills incorporating the Owensboro & Madisonville, and the Litchfield, Big Spring & Northern railway companies, have passed the Kentucky State Legislature.

Brunswick, Altamaha & Northern.—Organized in Georgia to build a railway from Brunswick to some point in McIntosh County. Among the incorporators are: C. L. Schlatter, W. E. Kay, C. P. Goodyear and J. T. Dent.

Fincastle & Troutville.—The preliminary surveys for this 7-mile Virginia railway have been made, and estimates are now being prepared. The locating surveys will commence soon. Wm. B. Simmons, of Fincastle, Va., is President, and E. Traves, of Iron Gate, Va., is Chief Engineer.

Ritch Patch Iron Co.—This company has commenced surveys for a railway from its mines at Low Moor, Va., to a connection with the Chesapeake & Ohio R. R., a distance of 6 miles. It is stated that the road willbe built at once. Maj. D. Shanahan, of Louisville, Ky., is President, and Carter H. Harrison, of Staunton, Va., is Chief Engineer.

NORTHWEST.—Existing Roads.

Northern, Pacific & Manitoba.—Tracklaying on the unfinished portion of the Morris-Branden extension has been commenced. All but about 5 miles of the line was completed last year. It is expected to open the road for traffic by June 1.

Port Arthur, Duluth & Western.—The bridge is completed across the Kaministiqua River and work is progressing on the line west. Tracklaying will begin as soon as the ground settles.

St. Louis, Alton & Springfield.—This road, running from Alton to Bates, Ill., 74 miles, has been purchased by the Illinois Central R. R. Co.

Duluth, South Shore & Atlantic.—It is announced that this company will soon commence the construction of its line from Iron River to West Superior, Wis.

Milwaukee & Northern.—The contract for building the extension from Iron Mountain to Escanaba, Mich., a distance of 54 miles, has been awarded to the McIntosh Bros., of Milwaukee, Wis. Work will commence at once.

Chicago & Northwestern.—This company has let the contract for double tracking a portion of its line between Chicago and Milwaukee. It is the intention of the company to double track the entire division.

Union Pacific.—The annual report of this company for the year ending Dec. 31, 1889, shows the following results from operations:

Gross earnings	$31,070,182
Operating expenses	19,874,211
Net earnings	11,195,971

Chicago, Fort Madison & Des Moines.—At a meeting of the stockholders, recently held, the following officers were elected: President, Willard T. Block; Vice-President, E. S. Conway; Secretary, Isaac N. Whittane; Treasurer, Edgar C. Long; Solicitor, Jesse A. Baldwin, and General Superintendent, Wm. P. Scott. It was voted to increase the capital stock $2,500,000. A contract was made with the Illinois & Iowa Construction Co. to rebuild the present line and make it standard gauge, and to extend it to Des Moines, either via Ottumwa or Oskaloosa.

Northern Pacific.—This company proposes to build a branch from Fargo to Red Lake Falls, No. Dak.

Chicago & Northwestern.—Reports are in circulation that the Vanderbilts are working to obtain an independent outlet to the Pacific Coast. They now reach the coast over their own lines to Omaha, Neb., and thence by a traffic arrangement with the Union Pacific Ry. to San Francisco. This arrangement is said to be unsatisfactory, and the intention is to extend the Chicago & Northwestern to San Francisco. It is also stated that they will furnish the money to build the extension of the Great Northern Ry. to Puget Sound. Connection is to be made between this line and the western extension of the Chicago & Northwestern by a line running from southern Idaho. This arrangement will give both companies outlets on the coast at San Francisco and Puget Sound.

Projects and Surveys.

Springfield & Hillsboro.—J. M. Stark, of Pawnee, Ill., President, writes us that this road is projected to run from Springfield, Ill., south through the towns of Rochester, New City, Zenobia, Hillsboro, and Donnellson, a distance of 50 miles. Surveys will commence immediately. The route is through a very favorable country, affording very easy grades and curves,

The right of way will be donated. J. E. Burtle, of Pawnee, Ill., is Chief Engineer.

Wisconsin Southern.—Incorporated in Wisconsin to build a railway from Shullsburg west to Rutledge on the Mississippi River, a distance of 30 miles. Among the incorporators are: Thos. Whitney, C. W. Higgins, Frederick K. Bowes, Wm. Glenn, and Henry L. Lee; all of Chicago, Ill.

Green Bay & Kewaunee.—Surveys are in progress for a railway from Green Bay to Kewaunee, Wis.

Duluth, Pierre & Black Hills.—It is announced that a construction company has been formed to build this road from Pierre, So. Dak., to Aberdeen, No. Dak. The line has been surveyed and a greater part of the right of way secured. Grading, it is stated, will be commenced at once.

Fremont & Yankton.—Incorporated in Nebraska to build a railway from Fremont, Neb., to Yankton, Dak. Among the incorporators are: W. R. Wilson, J. W Love, C. H. Toucray, J. E. Sherwin and C. C. Christensen, all of Fremont, Neb.

Sioux City & Ponca Belt.—A project is on foot to built a belt-line railway connecting Sioux City, Ia., and Ponca, Neb.

SOUTHWEST.—Existing Roads.

Cleveland, St. Louis & Kansas City.—Press reports state that a company has been organized by John O'Day and others for the purpose of purchasing this partly completed railway, and extending it west to Kansas City. The line is completed from St. Charles, Mo., west about 16 miles, and considerable grading has been done for about 25 miles further.

Kansas & Arkansas Valley.—At a meeting of the stockholders recently held it was decided to extend this road west and south into Texas.

Choctaw Coal & Railway Co.—Surveys, it is stated, will soon commence for an extension of this road to Denison, Tex.

Projects and Surveys.

Sherman, Denison & Dallas.—A press dispatch from Sherman, Tex., says:

Col. B. P. McDonald, President of the Sherman, Denison & Dallas road, arrived in this city to-day in company with J. J. Frey, Geo. A. Eddy, J. Ellery Anderson, J. Hagerman, Simon Stern, J. W. Maxwell and Mr. Green. Col. McDonald has ordered the survey, and says that the road will reach Sherman in 60 days. The party go to Dallas and will inspect the proposed route to the Gulf, which will be pushed to the mouth of the Brazos.

Camden, Louisiana & Sabine Pass.—J. B. Friedheim, of Camden, Ark., writes us that the reconnoisance for this line has been completed. The contracts for construction will be let some time during the summer. The principal business of the road will be in lumber and agricultural produce. The officers are: Asa S. Morgan, President, and J. Victor Pedron, Chief Engineer.

Southern Arkansas.—T. F. Doyle, of Dry Run, Ark., Superintendent, has furnished us with the following information:

This road is projected to run from Dry Run, Ark., on the St. Louis, Arkansas & Texas Ry. south to Hampton, Calhoun County, Ark., a distance of 23 miles. The surveys will be completed in a few days. The route is through a timber and farming region affording very light grades and curves. Nearly all of the right of way has been secured. The contracts for the construction of the road will be let about June 15. The company was chartered April 10, 1890. The officers are: John Bagley, Box 483, Chicago, Ill., President, John Brantley, of Dry Run, Ark., Chief Engineer.

ROCKY MT. AND PACIFIC. Existing Roads.

Montana & Canada.—Work will soon commence from Leithbridge south, and it is expected to have this portion of the line to the International boundary completed by Sept. 1. Work is already in progress from Great Falls, Mont., north. The line from Great Falls to the International boundary is to be completed by Aug. 1.

Oregon & Washington Territory.—The $2,000,000 which this company asked of the city of Portland in aid of the extension from Hunt's Junction to Portland, has been raised. Surveys for the line will begin about May 1, and the work of construction be commenced as soon afterwards as possible. The line will be about 220 miles long.

Astoria & South Coast.—The contract for the construction of the first 30 miles of this road has been let to J. H. Smith.

Rio Grande Southern.—A bill has been introduced into Congress, granting this company right of way through the Fort Lewis reservation.

Union Pacific.—Chief Engineer Bogue has recommended the early construction of the following extensions: From Porland, Ore., to Seattle, Wash.; from Vancouver, Wash., east to the Cascades, on the Columbia River; from Centralia to a point on Gray's Harbor, Wash.; from Alderton to Tacoma, Wash., from a point on the main line to the Durham coal fields, and an extension of the Tacoma Division to Olympia and Port Angeles, Wash. Construction on the extension to Pioche, Nev., and southwest is making good progress. About 1,800 men are now at work grading, and tracklaying will commence May 10. A large quantity of rails are on hand.

Oregon & Transcontinental.—The announcement it made that a syndicate has been formed to retire the first-mortgage bonds of this company. The objects of the retirement are stated to be a reduction to the interest charges, and for the purpose of paving a way to a reorganization of the company. The purpose of the reorganization has not been made public, but in a general way it is stated that the objects of the new company will be those of a large financial and, possibly, construction company.

Northern Pacific.—Chief Engineer Hendrick is quoted as speaking as follows, concerning the work this company has under way, and projected:

At Spokane Falls we will lay out new yards and build a new freight-house and new passenger depot, the improvements costing $365,000. We will construct a line to Lewiston, Idaho, probably beginning at Pullman, on the Spokane and Palouse Branch, extending thence through Moscany to the head of Bear Creek, thence down Bear Creek, Potlatch and Clearwater, to Lewiston. The length of the line will be 72 miles. In Washington State we will continue the construction of the line from Durham. In Western Washington we have in contemplation the construction of ample terminal facilities in Seattle. The cost of the improvements now contemplated will be $250,000. At Tacoma we are now receiving proposals for shops and additional trackage rendered necessary by the increase in the company's business there. East of Idaho our principal work is upon the line west from Missoula to the Coeur de Alene country.

Projects and Surveys.

Boise Central.—Chas. A. Clark, of Boise City, Idaho, sends us the following concerning this road:

The intention of this company is to build a railway from Boise City, Idaho, northwest, via Middleton, to a junction with the Oregon Pacific R. R. No plans have yet been decided upon beyond this. The length of the road will be 47 miles, of which distance 20 miles have been surveyed. The route is along the Boise River, passing through a rich farming country. The company was chartered March 24, 1890. C. W. Moore is President.

Helena & White Sulphur Springs.—There is a project on foot to build a railway from Helena, Mont., to White Sulphur Springs and Castle, a distance of about 80 miles. The object of the road is to give an outlet from the mines to the railways centering at Helena.

Calgary & Edmonton.—A meeting of the stockholders will be held May 26 to authorize the issue of bonds and to make the financial arrangements necessary for the early commencement of construction.

Aberdeen & Hoquiam.—Chartered in Washington to build a double track railway from Aberdeen to Hoquiam, and thence along the shores of Gray's Harbor. Among the incorporators are: J. B. Metcalf, L. J. Weatherwax J. S. Kloeber and H. B. Lind.

FOREIGN.

Mexico.—The Department of Public Works has authorized Agustine Arriaga to build a standard gauge railway from Villa de Viezece to Villa de San Pedro, with power to extend the line to a connection with the Mexican Central Ry. between the stations of Torreon and Lerdo. Surveys are to begin at once and the construction in 6 months. The road must be completed in 3 years.—A concession has also been granted to Joaquin Casasus for a narrow gauge railway from Ixtaccihuatl and passing by volcano of Popocatepetl to connect with the Interoceanic or Mexican railways. Surveys must begin within a year and construction within 2 years. The road must be completed in five years.

Monterey & Mexican Gulf.—This road has now been completed from Monterey to Linares and from Monterey to Venadito. About 4,000 men are now at work between Linares and Tampico, and it is expected that the road will be completed to the Gulf within a year. The road is being built in a very substantial manner.

RAPID TRANSIT.

Electric Railways.—The Union St. Ry. Co., of New Bedford, Mass., proposes to adopt electric traction.

The Rochester Ry. Co., of Rochester, N. Y., is relaying it track with steel rails on concrete foundation. Poles and wire have been ordered. A contract has been let to the Gilbert Car Co., of Troy, N. Y., for 100 cars, 18 ft. long, with inclosed platforms or "vestibules." A contract for 25 miles of steel grooved rails has been let to the Johnson Co., of Johnstown, Pa. The company has applied for permission to build extensions.

The City & Suburban Ry. Co., of Memphis, Tenn., has purchased the Prospect Park line, 10 miles long, and will equip it with the Thomson-Houston electric system. An extension of 2 miles will also be built. An order for cars has been given to the St. Charles Car Co., of St. Charles Mo.

The Crescent Ry. Co., of New Orleans, La., has made a contract for the equipment of its cars by the Electric Traction & Mfg. Co. New cars have been ordered.

The Crown Point Electric Ry. Co. has been organized at Indianapolis, Ind., by F. B. Clark and John F. Leavey. Capital stock, $200,000.

The Duluth St. Ry. Co., of Duluth, Minn., has been granted an amended ordinance permitting it to adopt electric traction. The system will be adopted this summer.

The Kansas City & Blue Valley Ry. Co., of Kansas City, Mo., has increased its capital stock from $50,000 to $75,000 and will issue bonds for $75,000. The line will be built this year, from the eastern end of the 15th St. cable line to Manchester and Centropolis. Mr. W. B. Knight is the engineer.

A Sprague electric railway is to be built at Butte, Mont.

An electric railway is projected between McMinnville and Dayton, Ore.

The Gainesville St. Ry. Co., of Gainesville, Tex., will rebuild its track, lay about 10 miles of extensions and put in an electric plant.

Street Railways.—The Buffalo, Tonawanda & Niagara River Ry. Co. has been incorporated to build a street line 22 miles long from Buffalo to Tonawanda, Wheatfield and Niagara Falls. Capital stock, $600,000. The directors for the first year are Samuel B. Hard, of Englewood, N. J.; Isaac B. Newcombe, Herbert N. Curtis, Lathrop R. Bacon and Edmund C. Converse, New York City; Benjamin B. Hamilton, Buffalo, and Mills W. Barse, Olean, N. Y.

The Genesee & Water St. Ry. Co., of Syracuse, N. Y., has been granted permission to extend its lines.

The Alton & North Alton St. Ry. Co., of Alton, Ill., has been incorporated by Wm. Armstrong, W. D. Sparks and H. B. Sparks. Capital stock, $15,000.

Elevated Railways.—Work on the erection of the elevated railway at Sioux City, Ia., has been commenced by the King Iron Bridge & Mfg. Co., of Cleveland, O. Mr. C. E. H. Campbell, of Council Bluffs, Ia., is the engineer in charge for the contractors.

At St. Louis, Mo., work has been commenced on the erection of the Scott Elevated railway. Foundations for the columns are being built on Third St.

HIGHWAYS.

Massachusetts.—The following proposals have been received by the Water Board, Boston, Mass., for three roads in Ashland and Hopkinton, near the proposed Basin No. 5 of the Boston Water Works. The contract was awarded to Newell & Snawling:

Bidders.	Earth excavation. 30,000 cu. yds.	Rock excavation. 200 cu. yds.	Split stone masonry and mortar. 330 cu. yds.	Dry rubble masonry. 541 cu. yds.	Culvert paving. 311 sq. yds.	Rip-rap. 1,290 cu. yds.	Ballast. 100 cu. yds.	Fencing. 7,400 lin. ft.	20 Stone bounds.	Totals.
Newell & Snawling,	$0.31	$1.50	$7.00	$4.00	$1.00	$2.00	$1.00	$0.15	$1.00	
Uxbridge	12,090.00	300.00	2,730.00	2,164.00	311.00	2,460.00	100.00	1,110.00	20.00	$21,285.00
Auguste Saucier,	0.34⅙	1.75	10.50	3.89	1.75	2.50	1.00	0.15	0.50	
South Framingham	13,601.25	350.00	4,095.00	2,104.49	544.25	3,075.00	100.00	1,110.00	10.00	24,989.99
Thomas A. Rowe,	0.46⅓	1.75	10.00	3.50	0.60	1.00	0.50	0.20	1.00	
Newton	18,135.00	350.00	3,900.00	1,893.50	186.60	1,230.00	50.00	1,480.00	20.00	27,245.10
Moulton & O'Mahoney,	0.58	5.00	11.00	4.50	1 00	2.50	2.00	0.25	1.00	
Lawrence	22,620.00	1,000.00	4,290.00	2,434.50	311.00	3,075.00	200.00	1,850.00	20.00	35,800.50
Neill McBride,	0.70	0.70	10.00	5.00	0.75	3.00	1.00	0.20	2.00	
Brighton	27,300.00	140.00	3,900.00	2,705.00	233.25	3,690.00	100.00	1,480.00	40.00	39,588.25

Connecticut.—At West Hartford there are two contractors for the roads, Chas. Cotton and Wm. Hope, one in the north and one in the south part of the town. Each contractor has $3.25 per day for team and two men, they to work when and as the selectmen direct.

Missouri.—A meeting was held recently at Palmyra, the county seat of Marion county, for the discussion of the question of issuing bonds to the amount of $200,000 for the construction of gravel roads in the county. Committees were appointed to investigate the cost of gravel roads and to ascertain the necessary levy for $100 to pay bonds of 3½ and 4 per cent. for twenty years.

Maryland.—At Hagerstown Judge Alvey has granted a charter to the Clearspring Turnpike Co. The officers of the company are J. W. Troup, President; David Siebert Vice-President; John Wilson, Treasurer; Wm. T Hassett, Secretary, and Frank W. Mish. Attorney. The capital is $5,000. The company proposes to rebuild the turnpike leading from Clearspring to Big Conococheague.

Ohio.—A bill has been introduced in the Legislature to authorize the Commissioners of Hamilton County to issue bonds for $20,000 to grade, macadamize and improve Duck Creek road in Mill Creek, Columbia Township.

Washington.—The miles of plank streets in Whatcom and Sehome have stimulated the people of the county on the subject. The County Commissioners have ordered six miles of plank road built from Whatcom north toward Lynden, and the Lynden and Ten Mile people will extend the plank over the north end, making a continuous line of plank road from Whatcom to Lynden 12 miles long. Other sections of the county will demand plank roads.

New York.—At the special meeting of the village trustees of Chatham to receive proposals for working the roads, the contract was awarded to John Murray, his bid being $3.50 a day.

Alabama.—The public road matter will be one of the most important to be considered by the next General Assembly. Jefferson and Madison counties have already obtained permission to levy a special tax for road purposes exclusively.

WATER-WORKS.

NEW ENGLAND.

Machias, Me.—The Machias Water Co. has been organized and a code of by-laws adopted. The officers are: H. R. Taylor, President; Frank S. Ames, Clerk; Orris M. Vose, Treasurer. Directors: Dr. H. H. Smith, Chairman; G. W. Drisko, L. H. Crane, Secretary; Jos. A. Coffin, A. R. Gilson. Preliminary work will be started at once.

Georgetown and Parker's Point, Me.—It is reported that a system of works will be put in by Langdon Oliver, of Bath, to supply the cottages at these places with water.

Old Town and Veazie, Me.—A car-load of water pipe for use in these towns has arrived in Bangor. Work will be commenced at once, and the water will be turned on in the fall.

Reading, Mass.—Sealed proposals will be received by the water board until May 10 for trenching, laying and backfilling of about 14 miles of 6-in., 8-in., 10-in. and 12-in. pipe of cast-iron, and setting 141 stop-gates and 77 hydrants. Plans and specifications can be seen at the office of M. M. Tidd, Engineer, 10 Tremont St., Boston, where any necessary information will be furnished. A certified check for $500, made payable to the Treasurer of the town of Reading, will be required with each proposal.

Cottage City, Mass.—The Cottage City Water Co. has been organized. The officers are: Lucius H. Fuller, President; Zenas D. Linton, Vice-President; W. H. Bowker, Treasurer; John J. F. Mulhall, Secretary; who, together with Elisha Thayer and Hamilton J. Greene, compromise the Board of Directors.

Lenox, Mass.—John J. Marsh, Superintendent of the North Adams works, will resign his position on May 3, he having taken a contract to construct a system of works for this village.

Taunton, Mass.—About one mile of 8 and 6-in. pipe will be laid this season, and 12 hydrants, 15 or 20 valves and 75 or 80 meters, will be set. Superintendent Geo. F. Chace. The Water Board has ordered a 4,000,000 gall. Gaskill high duty pumping engine of the Holly Mfg. Co., of Lockport, N. Y. It is to be completed in October. The guaranteed duty is 100,000,000 foot pounds; domestic pressure, 55 lbs., and fire pressure, 110 lbs.

Great Barrington, Mass.—The town has acquired the franchise of the Great Barrington Water Co., and will vote again on June 2 on the question of acquiring the franchise of the Berkshire Heights Water Co. The question of securing the rights of the latter company was defeated by a citizens' vote on April 25.

Jamestown, R. I.—At a recent town meeting a special committee was appointed to see what could be done in the way of securing a system of works. Some of the systems propose taking their supply from driven wells, and others from Clark's pond, but they all provide for a standpipe on the Howland plat.

Hartford, Conn.—The Water Board has voted to extend the water pipe on Windsor ave for a distance of 4,163 ft. The estimated cost is $3,000. New mains will also be laid to replace old cement and iron pipe.

MIDDLE.

Batavia, N. Y.—The water bonds bill, which has become a law without the Governor's signature, enables the aldermen to raise $5,000 annually with which to pay the water bonds, and a sum which will be sufficient to pay the interest upon them, besides the $20,000 yearly for general purposes.

Syracuse, N. Y.—The bill authorizing the city to take its water supply from Skaneateles lake has passed the Assembly.

Shelburne, N. Y.—A new reservoir, having a capacity of 18,000,000 galls., is to be constructed. W. E. Davis is Superintendent.

Binghampton, N. Y.—Four miles of new pipe, 12 to 6 ins. in diameter, will be laid this season, and 25 new hydrants, 25 valves, and 30 meters will be placed. H. E. Allen is Secretary of the Commissioners.

Herkimer, N. Y.—Secretary Charles C. Spinner informs us that it is probable that a new boiler will be placed this season.

Schenectady, N. Y.—Six new hydrants and 20 valves will be set this season, and 6,000 ft. of 24 to 6-in. pipe will be laid. Address, George T. Ingersoll.

New York, N. Y.—The Aqueduct Board has adopted the plans submitted by Commissioner Gilroy, for Reservoir D, on the west branch of the Croton River. The reservoir will cost $1,000,000, and have a capacity of 9,000,000,000 galls. Corporation Counsel Clark has been directed to begin proceedings to secure the land.

Merchantville, N. J.—The Holly Mfg. Co., of Lockport, N. Y., has contracted to duplicate the pumping machinery which it furnished to the Merchantville Water Co. in 1886. Alexander J. Cattell is President of the company.

Bristol, Pa.—About 4,700 ft. of 6-in. pipe will be laid this season, and four new hydrants and eight new valves will be set.

Pittsburg, Pa.—About $150,000 is to be expended before July 1 in improving the water supply system in the vicinity of Oakland and Haselwood. The work will consist largely in replacing small pipe with 30 and 24-in. mains. At the pumping station about $20,000 additional is to be expended in putting a new cylinder head and a valve chamber on the engine, and in making other improvements. Superintendent George H. Browne has charge of all the work.

Huntingdon, Pa.—The water company will probably build a new reservoir this season.

Mechanicsburg, Pa.—Andrew Seifert, Superintendent, has sent us the following:

About 2 miles of 6 and 4-in. pipe will be laid this season, and about 20 new hydrants, and 20 6-in. and 10 4-in. valves will be set.

Mahanoy City, Pa.—We have received the following information from E. Silliman, Jr.:

The dam is to be raised 3 ft. this season. It is now 39 ft. high. About 1,500 ft. of 4-in. pipe will be laid, and 2 hydrants and one 4-in. valve will be set.

Salisbury, Md.—L. S. Bell, Secretary and Superintendent, informs us that 2,500 ft. of 6-in. and 4-in. pipe will be laid this season, and that 33 hydrants, 33 valves and 3 meters will be placed. Also that another pump and boiler may be added.

SOUTHERN.

Radford, Va.—The contract for constructing the new works has been awarded to B. C. Washington, of Charleston, W. Va.

Reidsville, N. C.—A majority vote was cast at the election on April 14 in favor of constructing works.

West End, Ga. (a suburb of Atlanta, Ga.)—The scheme to furnish West End with water from artesian wells is being urged by the citizens.

Atlanta, Ga.—The vote taken on April 23 on the question of issuing $250,000 of water bonds, was carried by more than the required two-thirds vote.

Savannah, Ga.—T. T. Johnston, Chief Engineer of the Memphis (Tenn.) Artesian Water Co., has submitted a report to the City Council. He recommends that the supply be increased by sinking additional wells, the construction of a new pumping station at the Springfield plantation, and concludes with the following recommendations:

1. A plan for an artesian supply should be adopted which contemplates a conduit from the present pumphouse to some point at or near the Springfield well. Surveys should be at once made over the possible routes for such a conduit in order to determine the best location, and to estimate definitely its cost, and make plans and write specifications for its construction if it should be adopted. This survey should also show the routes possible for a force main in order that its cost may be definitely figured and compared with the cost of a conduit.

2. Whether river water or artesian water be used, or whether pumps be located at present site or at city site, the pumps required for city service will be one and the same thing, though, of course, some slight differences would exist in shape and arrangement of pump house and delivery pipe. It takes a year to build a large pump, and a year and a half to get it in good running order. Specifications should at once be written for pumps, both vertical and horizontal, which will conform to the requirements. *Bids should be asked and contracts let*, for it is quite certain that, whatever is done to improve the water supply, it can easily be accomplished before pumps can be ready to realize it.

3. The matter of stand-pipe location and modification of distribution pipe should be considered.

Macon, Ga.—A new scheme for supplying the town with works has been projected. By it it is proposed to pump water from a spring located at the base of Brown's hill to a reservoir 60 ft. high. The spring is owned by G. M. Davis.

Gainesville, Ga.—It is reported that the City Council has appointed a committee of six to report as to the advisability of constructing works. Also that Dozier & Logan will receive prices on three to four miles of 4, 6, 8 and 10-in. wrought and cast-iron pipe and 30 to 40 hydrants, castings, boilers and engines.

Bridgeport, Ala.—At a recent meeting of the Directors of the Bridgeport Land and Improvement Co. it was decided to built water-works, an electric light plant, etc. The improvements will be commenced as soon as contracts can be made.

South Pittsburg, Tenn.—It is reported that a stock company has been organized to purchase the city works, and will build two 1,000,000-gall. reservoirs.

Barboursville, Ky.—Reynolds & Co., of New Albany, Ind., have been awarded a contract for sinking an artesian well for the Barboursville Land and Improvement Co.

West Covington, Ky.—A bill has passed the Senate to amend the town's charter, and authorizing the issue of $15,000 of bonds to secure a water supply by contract with any municipal corporation.

Winchester, Ky.—A proposition to empower the City Council to contract for a system of works will be submitted to a vote on April 26.

Harrodsburg, Ky.—A resolution has been unanimously adopted requesting W. W. Stephenson to secure an act authorizing the city to contract for and own a system of works, or to purchase a system constructed by a company, and to own and control the same.

C. D. Thompson, T. C. Bell and others are also in favor of having works established.

NORTH CENTRAL.

Marietta, O.—The new works have been completed. John W. Hill, Consulting Engineer, Cincinnati, O., was chief engineer.

Conneaut, O.—E. A. Miller, Master Mechanic of the N. Y. C. & St. L. R. R. Co., has sent ut the following:

The village has under consideration the granting of a franchise for constructing a system of works, to cost from $60,000 to $70,000, providing satisfactory arrangements can be made with some company.

Toledo, O.—Toledo has spent $2,000,000 for a water system, and is still using diluted mud.—Columbus (O.) *State Journal.*

Canton, O.—A bill has passed the Senate authorizing the town to issue and sell bonds for water-works purposes.

Sandusky, O.—Sealed proposals will be received by Charles A. Judson, Superintendent, until May 7, for furnishing and delivering on cars at Sandusky, O., approximately, 800 ft. of 12-in. and 5,000 ft. of 6-in. water pipe. The weight of the 12-in. pipe shall be 93 lbs., and of the 6-in. pipe 33 lbs. per lin. ft.; the limit of variation in weight allowed is 5 per cent. The pipe shall be 12 ft. 4 ins long; shall be coated in the usual manner and tested to 300 lbs. pressure per sq. in.

The 3,000,000-gall. pumping engine is to be repaired, and 10 new hydrants and 15 new valves will be set.

Indianapolis, Ind.—Vice-President F. A. W. Davis has sent us the following:

About 15,000 ft. of 24 to 6-in. pipe will be laid this season, and 25 to 30 meters, 30 new hydrants and 20 new valves will be set.

Bay City, Mich.—As a means of increasing the efficiency of the existing works the superintendent has recommended that two 10-in. mains be laid to the south end of the city, at a cost of about $20,000. It is probable that the committee of aldermen which is to consider the matter, will report in favor of making the extension.

Birmingham, Mich.—We have received the following from George E. Danier:

Work was commenced on April 1, and is to be completed by June 15. Estimated cost, $15,000, procured by town bonds. Water will be furnished by direct pressure. F. Hageman is chairman of the water board. Engineer in charge, George E. Danier. Population, 1,000.

We have received the following information from officials, stating the work contemplated, or decided upon, to the following works this season:

Ironton, O.—Large additions to the pumping power will be made this season. Probably no extensions will be made.

Martin's Ferry, O.—About 5½ miles of 12 to 4 in. mains will be laid this season, and 34 new hydrants and 84 valves will be set.

Logansport, Ind.—"We are now engaged in the effort to procure pure water from wells."

Manistee, Mich.—About one mile of 8 in. mains will be laid.

Muskegon, Mich.—About 2 miles of 6 and 4-in. mains will be laid, and 20 two-way 2½-in. nozzle hydrants and 15 6 in., and 10 4-in. valves will be set.

"Have voted to bond the city for $250,000 for a new plant, to take water from Lake Michigan, which will take 1½ miles of 20 in and ¾ of a mile of 30-in. pipe."

Superintendent, William Dixon.

Lansing, Mich.—About 6 miles of 6 and 4-in. pipe will be laid, and 50 hydrants, 16 valves and 12 meters will be set.

Bloomington, Ill.—Seven thousand feet of 6 in. pipe will be laid, and 14 hydrants and 4 valves will be set. Superintendent, H. W. Schmidt.

Rockport, Ill.—A new 6,000,000-gall. engine is to be placed, 2 miles of 6 and 4-in. mains will be laid, and 10 hydrants will be set. Superintendent, John T. Lakin.

Rock Island, Ill.—About 3,000 ft. of 6 in. pipe will be laid, and 6 hydrants and 6 valves will be set.

Jacksonville, Ill.—Twelve hydrants and 12 valves will be set, and 5,700 ft. of 6 in. pipe will be laid.

Quincy, Ill.—Fifty meters, 24 valves and 12 hydrants will be set, and 2 miles of 6-in. pipe will be laid. William B. Bell is Superintendent.

Greensburg, Ind.—The new works have been satisfactorily tested by the Contractor, Samuel R. Bullock. Cost, $60,000.

NORTHWESTERN.

Iowa Falls, Ia.—It is reported that a system of works is to be put in this season.

Creston, Ia.—Work has commenced. The works will be in operation by July 4.

Council Bluffs, Ia.—Chief Engineer H. Birkinbine has sent us the following:

A 10,000,000-gall. subsiding reservoir is being constructed. Two to 4 miles of pipe will be laid this season, and 25 to 50 new hydrants will be set.

Marshalltown, Ia.—About 3,000 ft. of 6-in. pipe will be laid, 6 new hydrants and 5 new valves will be set. A new 2,000,000 Gordon pumping engine is to be erected. J. G. Trotter is Superintendent.

Dubuque, Ia.—Five new hydrants and 7 new valves will be set, and one mile of 6-in. pipe will be laid.

Cedar Rapids, Ia.—Superintendent Charles J. Fox informs us that they will place 12 or 15 new meters, 5 hydrants and 10 valves, and lay 6,000 ft. of 6-in. cast-iron pipe.

Topeka, Kan.—The water mains are to be extended to North Topeka.

Pittsburg, Kan.—The Pittsburg Water Co. has been incorporated, with a capital stock of $250,000.

Leavenworth, Kan.—The new settling reservoir will have a capacity of 13,000,000 galls.

Fort Leavenworth, Kan.—A 6-in. main will be laid to the west end. The present 4-in. main does not give sufficient force when the smaller pipes running into buildings are attached.

Oxford, Neb.—A petition is in circulation asking the village board of trustees to call an election to vote bonds for a system of works.

Sioux Falls, Neb.—Improvements to the amount of $75,000 will be made to the works this spring.

Hermosa, So. Dak.—New works are to be established.

Fort Sully, So. Dak.—The contract for building the new works has been let for $2,900. The cost of the plant when completed will be about $25,000, the government furnishing all the material. About 1¼ miles of pipe will be laid at the present time.

SOUTHWESTERN.

El Paso, Tex.—The attempt of the water company to restrain the city from issuing $100,000 of bonds to bore an artesian well, and construct and maintain works, claiming an exclusive franchise for 17 years, has been defeated; Judge Maxey having refused to grant the injunction, as the State Constitution provides that perpetuity and monopoly are contrary to the genius of a free government and should never be allowed. The case was appealed to the United States Supreme Court.

Cisco, Tex.—W. G. Veal, representing a Fort Worth company, has made a proposition to construct works.

Rockdale, Tex.—The Rockdale Water Co. has been incorporated by J. S. Perry, C. H. Coffield, J. L. Lockett and others. Capital stock, $50,000.

Colorado Springs, Colo.—The Dixon Land & Water Co. has been incorporated.

Trinidad, Colo.—The new reservoir has been completed and put into use.

Aspen, Colo.—The Aspen Water & Light Co. has commenced suit against that city for $300,000 damages, claimed to have been sustained by reason of the Town Trustees having rescinded an ordinance granting a franchise to the company.

Cortez, N. M.—W. H. Wells, Superintendent and Chief Engineer of the Colorado Water Supply Co., has sent us the following:

The Colorado Water Supply Co. and the Dolores No. 2 Land and Canal Co. will be operated during the coming season under a joint management beginning April 1, with offices at Cortez, and until further notice under the name with S. W. Carpenter as the General Manager.

PACIFIC.

Paseo, Wash.—The new works are to be put in by W. P. Gray.

Tacoma, Wash.—The Tacoma Light & Water Co. has placed $1,700,000 bonds with the Philadelphia Trust, Safe Deposit and Insurance Co., to raise funds to improve the water service in this city. The company's capital stock is $2,000,000.

Dayton, Wash.—J. T. Jones, C. E., of Walla Walla, states that Dayton can procure water for a gravity system of works a short distance up the Touchet River.

Dallas City, Ore.—The Water Commission has received a bid for the water bonds, offering $1,100 premium for all the bonds, and to take them at 6 per cent.

Santa Ana, Cal.—Bids will be received until May 19, by the Santa Ana Trustees, for plans and specifications for water-works, not costing over $50,000, and having a daily capacity of 1,500,000 galls. The Trustees will pay $300 for the plans selected.

Lyons, Cal.—The Lyons and Nesterville Water Co. has been formed by John T. Wright, H. N. Morey, W. A. Rice and others.

Los Angeles, Cal.—The La Sierra Water Co. has been incorporated with a capital stock of $5,000,000; $500,000 has been subscribed. The directors are: J. DeBarth Shorb, Emanuel L. Stern, Tom J. Weldon, W. G. Hughes, and Herman Silver.

Oceanside, Cal.—The contracts for the Oceanside City water system have been signed by President Holmes and returned, and have been accepted and filed with the City Clerk, and the bonds have been placed. The system is to be completed within five months. Work will be begun at once.

San Bernardino, Cal.—F. C. Finkle, Engineer and Superintendent, informs us that contracts for constructing the new works have been awarded as follows:

Lacy Mfg. Co., of Los Angeles, for building the conduit, $1 15 per ft. C. Froelich, Jr., San Francisco, 64 Matthews hydrants at $29.75 each, and 6 extension hydrants at $95 each. Geo. M. Cooley, for furnishing the 3-in. kalamein pipe at 29¾ cts. per ft.; 4-in. kalamein pipe at 42.2 cts. per ft.; 6-in. kalamein pipe at 67½ cts. per ft.; 8-in. kalamein pipe at 90¾ cts. per ft.; 10-in. kalamein pipe at $1.40½ per ft.; 12-in. kalamein pipe at $1.84¾ per ft.; special castings at $790.12. Valves, C. Froelich, Jr.: 2 12-in. gates at $47.55 each; 1 10-in. gate at $37.83; 2 8-in. at $26.45 each; 3 6-in. at $18.40 each; 79 4 in. at $10.20 each, and 3 2-in. at $7.82 each.

San Francisco, Cal.—The following is taken from the *Daily Call:*

There is a proposition before the Board of Supervisors to bring a 30,000,000-gall. supply of water from Lake Tahoe for the sum of $15,000,000. The party making this proposition says he will secure the city against litigation as to the right of the company to make the use of water proposed.—Ultimately the city will go to the mountains for water. Corporations at best afford but an indifferent quality of water. How to harmonize the interest of the city with the equities the Spring Valley Co., many fairly plead, is one of the problems now before the public.

Wheatland, Cal —Work on the tower has been commenced. It will have a capacity of 60,000 galls.

Oakland, Cal.—At a recent meeting of the Directors of the Blue Lakes Water Co., the following officers were elected: Timothy Guy Phelps, President, V. D. Moody, Vice-President, and the First National Bank, of Oakland, Treasurer.

Los Angeles, Cal.—The Los Angeles City Water Co. has commenced suit against the East Side Spring Water Co., to enjoin and restrain it from erecting public works and for $14,705.

San Diego, Cal.—The contract for building the Pamo dam and flume has been awarded to Moore & Smith, of San Francisco, and Carle & Croley, of Sacramento, have been awarded a sub-contract. The price for construction and material is $700,000, and work and material will be paid for as the flume is completed.

Salt Lake City, Utah.—The Utah Water Co. has filed articles of incorporation. They call for a 50-year limit to the corporation, and fix the capital at $3,000,000, to be divided into 30,000 shares. The pursuit and business of the company will be the construction, maintenance, purchase lease, ownership and operation of water-works for the supplying of Salt Lake City with water for public, private, mechanical, manufacturing, culinary and domestic purposes, and the supplying of other cities and towns in the Territory of Utah in the same manner; the building, purchase, ownership and occupation of canals, dams, ditches, flumes and other apparatus for storing, collecting and distributing water for all purposes throughout the said Territory. The incorporators are: James Glendinning, Nicholas Treeweek, Abraham Hanauer, Dennis Sullivan, Richard Mackintosh, John J. Daly, W. S. McCormick, R. C. Chambers and John E. Dooley. The officers are: Richard Mackintosh, President; John J. Daly, Vice-President, and Nicholas Treweek, Secretary.

Lewiston, Idaho.—Articles of incorporation, and a franchise, have been granted by the City Council to a water and light company. Ten thousand dollars of the stock has been taken by citizens. The capital stock is $30,000. The following officers have been chosen: President, W. E. Kettenbach; Vice-President, C. J. Smith; Treasurer, C. C. Bunnell; Secretary, F. W. Kettenbach. The president has been authorized to appoint a surveyor to make surveys and estimates of the work contemplated. The company has pledged itself to begin work within 90 days, and to have the plant in operation in one year. The water will be taken from Clearwater, at the Lindsay Place.

CANADA.

New Glasgow, N. S.—The town has voted to issue $50,000 of bonds for improving the water-works, etc.

Ingersoll, Ont.—Moffett, Hoedgkins & Clarke, of Syracuse, N. Y., contractors for the new works, will commence work in May. The plant is to be completed in October. Water will be pumped from Choates Pond to a stand-pipe. There will be 7 miles of pipe and 65 hydrants.

Brandon, Manitoba.—Tenders will be received until May 15 for furnishing plans for a system of works, including sources of supply, plans of works, estimates of cost, running expenses and receipts, and the question of Probate vs. Municipal control. A premium of $500 will be paid by the City Council for the plan and estimates accepted.

PROJECTS.

Sheldon, Ia.—Preston, Mo.—New Castle, Va.; New Castle Land & Improvement Co.—New Holland, Pa.; G. H. Rauch.—Mineral Water, Tex.—De Land, Ark.—Macon, Miss.; W. G. Selleck.—Monroe, La.; A. J. Herring.—Childress, Tex. Mohawk, N. Y.; E. D. Smalley.—Tooele City, Utah; Tooele Water Co.; F. M. Lyman, President.—Whitewood, So. Dak.—Rocky Ford, Colo.—Madison, Fla.; W. S. Jordan or P. S. Marks.

FOREIGN.

Mazatlan, Mexico.—The new works will be completed about the middle of May. Twenty miles of pipe have been laid and reservoirs, etc., have been built.

ARTESIAN WELLS.

Waco, Tex.—The Mount Linn Town Co. has been organized with a capital stock of $100,000. It is reported that they will sink artesian wells and make other improvements.

Warsaw, N. Y.—The Town Board has advertised for sealed proposals to sink public artesian well No. 2. The first one sunk cost $300.

Graceville, Minn.—The Village Council will receive bids for sinking a well. Address E. C. Baird, Village Recorder.

Abilene, Tex.—Proposals are wanted until June 2 for constructing a well. Address Henry Sales, Chairman Artesian Well Committee.

Wolsey, S. Dak.—A company of mill owners has made a proposition to the citizens to put down a well.

IRRIGATION.

Kimball, Neb.—The citizens have voted to issue $24,500 of bonds to aid the construction of a water power irrigation system.

California.—L. D. Matthews, of San Francisco, has returned from his investigating tour in Owens Valley, Inyo Co., and pronounces the conveying of the waters of Owens River into the Salt Wells valley as feasible. Large storage dams will be built on sites already selected. The building of a large canal and the necessary reservoirs for water storage will cost about $1,0 0,000. The right of way for the canal, it is stated, has already been obtained.—E. C. McClellan, of Tuscarora, Neb., has made a preliminary survey for a storage dam across the north fork of the Owyhee River, to be 65 ft. high. It would form a lake 6½ miles long by ¾ of a mile wide, with an average depth of 35 ft. This would give water to irrigate 40,000 acres on the east side of the valley. For the west side a second reservoir would be constructed, to be supplied by the overflow from the main dam, and from Sheep Creek. This would require an enbankment nearly 5 miles long and 35 ft. high. A reservoir would be formed 5 miles long and 2 miles wide, with an average depth of 15 ft.

Turlock, Cal.—Bids for 11 miles of canal for the Turlock Irrigation District have been received as follows:

	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.
San Jose Imp. Co.	$21,000	$26,000	$17,160	$8,572	
Heitchew & Meadow Co	20,160	25,586	15,600	7,589	
L. H. Ware	.....	.....	17,160	26,184	
Pacific Bdg. Co.	29,800	28,560	37,740	21,884	10,558
S. S. Watson	49,740	14,080	16,640	12,430	7,994
W. H. Gray	24,300	30,740	63,650	7,068	
L. C. Worthington	41,140	.....	.....	.....	.....

Denver, Colo.—The Madden Ditch Co. has filed articles of incorporation. The business of the company will be to construct and operate an irrigating canal, with Little Dry Creek as the source of water supply. The capital stock of the company will be $2,000. The incorporators are James Moore, Henry A. Madden, William N. Madden, Frederick L. Madden and Hamet E. Whittemore.

Las Vegas, N. M.—Articles of incorporation have been filed by the New Mexico Irrigating Ditch Co., recently organized, with a capital stock of $5,000,000. The object of the company is to construct and maintain reservoirs, canals and pipe lines for the purpose of supplying water for irrigation, mining and manufacturing. The directors are: Marcus Brunswick, Stephen E. Booth, Charles J. Murray, William J. Mills and Wilson Waddingham, all of San Miguel County.

SEWERAGE AND MUNICIPAL.

Sewerage.—At Hillsborough, N. H., several citizens have combined to construct a private sewer, and work has already commenced. This may lead to the village putting in the system of sewerage for which plans were drawn several months ago, but rejected when submitted to vote.

At North Adams, Mass., a committee has been appointed to prepare plans and estimates for, and to make a report upon, a sewer from the swamp to the Hoosac River.

The Board of Aldermen, Lynn, Mass., have authorized the Drainage Committee to spend $35,000 in completing sewers left unfinished last season.

The sewers at White Plains, N. Y., are to be completed under the supervision of Wm. B. Ryder & Son, engineers, of South Norwalk, Conn.

At Corning, N. Y., the contract for extending the sewer system has been let to Denison & Lawrence.

The estimate for the Brandywine intercepting sewer and branches at Wilmington, Del., is $95,877.67. Mr. T. C. Hatton is the engineer.

The City Council of Danville, Va., has appropriated $15,000 for the completion of the sewerage system.

The Mayor and Aldermen of Talladega, Ala., have voted an issuance of $30,000 of bonds for a system of sewerage. They have been placed with the Fidelity Banking Co. of Toronto, Canada, at par, with accrued interest.

The City Council of Vicksburg, Miss., has let the contract for making surveys, plans and estimates for a system of sewers to J. H. Hayney, of Little Rock. Work is to be completed by Aug. 30.

At Tiffin, O., plans for extending the sewer at a cost of $40,000 have been prepared by Mr. Gormley, City Engineer.

The City Council of Eugene, Ore., has authorized a committee to locate the sewerage system and to secure a competent engineer to prepare plans and make estimates as to the cost of construction. A sum not exceeding $50,000 will be expended for the purpose, and the bonds have already been advertised.

Drainage.—Work has been resumed again on the Hell Slough and Shipman Slough drains at Jolley, Ia. On the former there has been constructed, by dredge No. 2, Marion Steam Shovel Co., 8 miles of main line ditch, and there remain 5½ miles yet to be excavated. On the latter, dredge No. 4, Bucyrus Steam Shovel & Dredge Co., has constructed 7¼ miles of ditch and still has 4½ miles to excavate, making 25½ miles, or a total excavation of 1,500,000 cu. yds. W. H. Wheeler & Co., of Portsmouth, O., are the contractors. J. G. Spielman, of Fairfield, Ia., is the engineer.

Street Work.—The Contracting Board, Troy, N. Y. has advertised for proposals for paving River St. from Hoosick St. to the city line and Hoosick St. from River St. to 10th St. with granite blocks. This will make about 1¼ miles of paving. The road-bed will be prepared and hardened by the use of a 10-ton steam roller. The joints between the blocks will be filled by paving cement obtained from the distillation of coal tar. Specifications have been presented for paving 8th St. with fire brick, and No. 4th St. between Federal and Jacobs Sts., with Trinidad asphalt on concrete foundation. The owners of property on 5th Ave. and 7th St. have petitioned for an asphalt pavement.

The City Engineer of Dunkirk, N. Y., has been directed to prepare an estimate of the cost of improving Central Ave. by macadamizing the roadway to the alternative widths, 30 and 39 ft., paving the gutters to a width of 5 ft. with boulders, laying the necessary 5-in. curbing, gutter flagging and cross walks. Also to furnish an estimate of the cost of paving both sections of Central Ave. with ordinary fire-brick, Hallwood block, Hayden block, first-class

Medina stone, and second-class Medina stone. The paving committee has recommended the macadamizing of the streets.

At the special election held April 22, the citizens of Hagerstown, Md., decided by a majority of 547 out of a total vote of 1,213 to create a fund of $30,000 for drainage and street improvement purposes. This is in addition to $30,000 already expended in this direction.

At Tampa, Fla., a contract for 30,000 sq. yds. of cypress block pavement has been let to Matthew Hays, of St. Augustine.

The City Council of Salida, Colo., is said to be considering the advisability of paving the principal business streets with a mixture of clay and sand, which hardens and makes a waterproof and a very hard and serviceable pavement. The clay is of peculiar quality, and is found only ½ mile from Salida.

Mr. M. J. Mack, C. E., of Salt Lake City, Utah, has stated that the Territory possesses vast quantities of asphalt, and the necessary tests should be made to determine whether it possesses the qualities contained by that in successful use for paving.

Sewers.—The following proposals for sewers for Philipsburg, N. J., have been received by C. Ph. Bassett, M. Am. Soc. C. E., of Newark, N. J.:

to the Albany Electric Illuminating Co. for five years beginning June, 1891: furnishing and erecting new lamps, $45 per lamp; lighting 531 to 600 lamps, 39½ cts. per light per night; globes 75 cts. each; repairs, $7 per lamp per year; changing lamps from place to place, $5.25 per lamp; no charge for cleaning. For additional lamp posts, including erecting, $6 each; for additional poles for wires, including erecting, $2 50 each.

At Tyrone, Pa., the streets have for three years been lighted by 25 c. p. incandescent lamps, the contractors maintaining 100 on the basis of a charge of $1.33 per lamp per month, moonlight schedule. As the contract expired on May 1, the authorities asked for tenders for another three years' contract. Tyrone Electric Light Co, 25 c. p. lamps (100 in number) moonlight table, $1.50 per month each; all night and every night, $2; Jones & Underhill, Columbus, for naphtha lamps, $19 per lamp per annum.

At Baltimore, Md., an ordinance has been passed authorizing the Mayor to contract, at a sum not exceeding 40 cts. per light per night, for the term of 3 years, for lighting the streets with electric lights. Proposals to be invited by advertisement, and to be opened June 2; the contract to take effect October 2.

At Vincennes, Ind., a 10-years' contract has been made for lighting by 200 incandescent lights of 30 c. p., at $30 per

track will remain to be done. The third span from the Ohio shore was put up in 30 hours, and it is intended to push work on the channel span, the false work for which is now nearly ready, with the same rapidity. It is thought the span will be in position by May 1, with the exception of the bolting and riveting which will remain to be done. Paige, Carey & Co. are making rapid progress on the Terminal railway work below the creek. The north end of the Chapline Hill tunnel is being pushed in as rapidly as possible. At the south end the work has progressed with equal rapidity, but does not show up so well, on account of being distributed over so much larger a field. The stone work for the two bridges is well under way and the fill in Caldwell's field, below Chapline St., is almost up to grade. The run has been substantially straightened from Woods St. to Eoff, and the approach to the tunnel portal will soon be in such shape as to make it possible to begin underground work.

Chappell's, S. C.—The county commissioners of Edgefield and Newberry counties contemplate constructing a bridge over the Saluda River at this place.

Pickens C. H., S. C.—The commissioners of Pickens and Oconee counties will let the contract on May 18 for building a bridge over the Keowee River.

Sangamon Co., Ill.—The county commissioners have

SECTION A.

Bidders.	24-in. pipe, 825 ft.	24-in. pipe, Y's.	18-in. pipe, 675 ft.	18-in. pipe, Y's.	15-in. pipe, 850 ft.	15 in. pipe, Y's.	12-in. pipe, 625 ft.	12-in. pipe, Y's.	9-in. pipe, 250 ft.	9-in. pipe, Y's.	Concrete, 85 cu. yds.	Rock per cu. yard.	House connections.	6 basins complete.	11 inlets complete.	110 ft. manholes per ft. under 12 ft.	Manholes, per foot, over 12 ft.	Lumber per M. ft. B. M.	Castings, 5,000 lbs.	8-in. pipe and masonry outlet complete.	Totals.
	$	$	$	$	$	$	Cts.	Cts.	Cts.	$	$	Cts.	$	$	$	$	$	$	Cts.	$	$
M. O. Hagen	1.75	2.45	1.34	1.35	1 05	1.00	0.70	64	56	45	6.00	2.50	39	85.00	35.00	2.75	3.50	25	3½	85.00	5,226.75
C. B. & F. A. Cadwell	1.70	2.50	1.38	1.24	0 89	1.00	0.78	70	43	.....	6.00	4.00	20	90.00	35.00	4.00	4.00	40	2¾	90.00	5,216.50
T. M. Lescher	1.63	3.58	1.50	1.82	0.81	1.43	0.60	99	53	.....	5.00	1.50	.....	110.00	39.50	3.50	4.00	.....	.....	74.00	5,166.96
S. B. Mutchler	2.12	1.25	1.25	0.75	1.10	0.60	1.00	40	75	.....	3.50	1.70	.....	100.00	50.00	3.00	.....	27	4	100.00	6,044.25

SECTION B.

Bidders.	40x60 ins. brick sewers, 1,450 ft.	Y's.	36x54 ins. brick sewer, 1,300 ft.	Y's.	18-in. cast iron pipe, 900 ft.	Y's.	13 basins, complete.	10 inlets, complete.	74 manholes under 12 ft.* complete.	Manholes, over 12 ft., complete.	12-in. pipe, 325 ft.	Y's.	9-in. pipe, 250 ft.	Y's.	Lumber, per M. ft. B.M.	Castings, 4,000 lbs.	Concrete, per cu. yd.	House connections.	Rock, per cu. yd.	Totals.
	$	$	$	$	$	$	$	$	$	$	$	Cts.	$	Cts.	$	Cts.	$	Cts.	$	$
T. M. Lescher	5.08	6.24	4.47	5.47	.....	.....	110.00	39.50	3.50	4.00	0.67	.....	0.38	.....	.....	.....	4.00	.....	1.50	19,624.75
O. Hagen	5.30	0.25	4.70	0.25	4.10	.....	85.00	35.00	2.75	3.50	0.66	70	0.56	45	22.00	3½	6.00	39	3.00	19,638.00
R. A. Malone	5.50	.....	5.00	.....	4 50	.....	50.00	50.00	2.00	2.00	1.75	.....	1.50	.....	25.00	4	5.00	40	2.50	20,926.75
D. W. Haggerty	5.90	.....	5.20	.....	2.20	.....	85.00	35.00	2 75	.....	0.95	.....	0.80	.....	.....	2¾	1.50	.....	1.70	21,542.25
C. B. & F. A. Cadwell	6.35	0.45	5.25	0.45	4.50	3.00	90.00	35.00	4.00	4.00	0.78	.....	0.43	.....	50.00	2¾	6.00	30	4.00	22,369.50
S. B. Mutchler	6.50	.....	6.00	.....	2.20	.....	100.00	50.00	3.00	.....	.....	.....	.....	.....	27.00	4	3.50	.....	1.70	23,879.50

Water Power.—The Missouri River Power Co., of Helena, Mont., has been incorporated by A. J. Davidson, J. H. Laurence and A. M. Holter. Capital stock, $2,000,000. A dam will be built to form a reservoir for water power.

At Winnipeg, Man., an agreement has been drawn up between the city and the Assiniboine Water Power Co.

A dam for water power is to be built at North Anson, Me., by D. E. Waite, of Holyoke, Mass.

Street Sprinkling.—The Mayor of Helena, Mont., made the following remarks in his last message: "I suggest the expediency for the organization of a joint stock company with a capital sufficient to provide the plant. In eastern cities the privilege of sprinkling the streets is eagerly sought for, indicating that the returns in dividends make the investment in capital a paying one."

ELECTRICAL.

Electric Lighting.—The Committee on Street Lighting, Holyoke, Mass., will receive proposals until May 9 for lighting the streets for 5 years with 125 full arc or 160 half arc lamps. For particulars address Mr. M. P. Conway.

At Southington, Conn., a contract has been made with the Tramway Co. for 80 lights of 25 c. p. at $1,000 per annum.

The following bids for a dynamo generator for the Statue of Liberty in New York harbor have been received by Major D P. Heap, U. S. Lighthouse Engineer, Tompkinsville, N. Y.: U. S. Electric Light Co., New York, $2,400 for 2 dynamos, $1,200 for 1 dynamo, $170 for duplicate armature; National Electric Light Co., Eau Claire, Wis., $2,500, $1,300, $375; Thomson-Houston Electric Co., New York, $3,548, $1,774, $265; Troy Electric Dynamo Co., Troy, N. Y. $1,983, $993, $375; United Edison Mfg. Co., New York, $3,991, $1,933, $500.

The Board of Contract, Albany, N. Y., has let a contract

year per light, or $6,000 per year. All additional lights ordered by the city are to be paid for at the same rate.

The City Electric Lighting Co., of Kalamazoo, Mich., has been incorporated, and has applied for a franchise President, Geo. C. Burnham; Secretary, George I. Goode now. Capital stock, $30,000.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—***Brockville, Ont.***—Measures are to be taken at once to secure a charter from the American authorities for the proposed bridge across the St. Lawrence River. The length of the bridge will be about 4,687 ft.

Intercolonial Ry.—Bids will be received until May 17 for the construction and delivery of 11 pairs of steel plate girders for deck bridges of 40 ft. clear span. Plans and specifications can be seen at the office of the Chief Engineer, P. S. Archibald, Moncton, N. B.

Toronto, Ont.—Bids will be received by the City Engineer for the construction of two steel bridges in the city of Toronto, Ont. Plans and specifications can be seen at the City Engineer's office.

West Claremont, N. H.—The Connecticut River R. R. Co. will rebuild with iron its bridge at this place.

Somerville, Mass.—The Boston & Lowell R. R. is re building the bridge over its tracks at Central St.

Washington, D. C.—A favorable report has been made upon the bill appropriating the sum of $60,000 for a stone or iron bridge across the Eastern Branch, on the Bennings road, to take the place of the present structure.

Stockport, O.—The contract for the bridge across the Muskingum River, at this place, has been let to T. B. Townsend, of Zanesville, O.

Howardsville, Va.—About $50,000 have been subscribed toward the construction of an iron bridge across the James River at this place.

Wheeling, W. Va.—Work on the Union R. R. bridge is rapidly nearing a stage where only the laying of the

awarded contracts for the construction of 8 new county bridges, the masonry to Wm. Lardner, Wm. Dickson, C. M. Driver and Eli Crum; the cement contract to L. S. McKallip & Co. The Pittsburg Bridge Co. got the contract for iron work.

Tazewell Co., Ill.—Bridges will be built across Lick and Mud creeks, in this county. The structures will be of iron, and will cost $2,500 each.

CONTRACTING.

River Work.—The following proposals for work a Crevasse in the Sacramento River were opened April 19 at the U. S. Engineer office, San Francisco, Cal.:

James Simpson; 35 cts. per ft. for 300 piles, 40 ft. long; $6.50 per pile for driving 300 piles; $2.25 per cu. yd. for 2,700 cu. yds. of brush; 35 cts. per bag for 10,000 bags filled with sand: 30 cts. per ft. for 1,800 lin. ft. of wale pieces 4x12 ins.; total, $16,265.

John P. Sheldon; 22 cts. for piles, $15 for driving piles, $1.69 for brush, 47 cts. for sand, 31 cts. for waling; total, $16,961.

Thos. H. Williams, Jr.: 40 cts. for piles, $9 for driving piles, $2.25 for brush, 50 cts. for sand, 30 cts. for waling; total, $19,115.

San Francisco Bridge Co.; 30 cts. for piles, $6 for driving piles, $4.95 for brush, 49 cts. for sand, 20 cts. for waling; total, $24,025.

Jas. A. McMahon; 40 cts. for piles, $7.50 for driving piles, $6 for brush, 30 cts. for sand, $1.25 for waling; total, $28,500.

The California Bridge Co. bid $17,470 and $16,840 on alternative specifications.

New Croton Aqueduct.—The Aqueduct Commissioners, New York City, have awarded the contract for Shaft No. 17½ to Thomas O'Hern, at $1,467.50. J. M. Waddle bid $1,498.75, and C. J. Kalmbach bid $1,600.50. The contract for three cast iron covers for Shafts Nos. 23,

23 and 24 has been awarded to Coldwell, Wilcox & Co., at 3¾ cts. per lb. for 4,500 lbs., $168.75. The Jonson Foundry & Machine Co. bid 5 cts., $225.

Steel Sewer Pipe.—At Manchester, N. H., proposals have been received by the Committee on Sewers and Drains for 302 ft. of steel sewer pipe, 48 ins. diam., ¼ in. thick. The S. C. Forsaith Machine Co. bid as follows: To be made of boiler sheet steel, $1,980; of tank steel, $1,880, or of shell steel with flanges, $2,165; with flanges faced up, $2,265. with $100 reduction if made of tank steel. The Manchester Locomotive Works bid $2,450, or $2,277 with slip joints. The Amoskeag Manufacturing Co. bid $2,772.25 for boiler steel and $2,000 for tank steel. The Lowell Steam Boiler Works bid as follows: As per specifications, $1,562; with wrought iron rings bolted, $1,698; with cast iron flanges, $1,827. The committee voted to accept the lowest bid of the Lowell Steam Boiler Works, $1,562. This bid is for continuous joints, all riveted, calked in first-class manner.

Sewer Pipe.—The Committee on Sewers and Drains, Manchester, N. H., has received the following bids: Portland pipe, Pettee & Adams, 75 per cent. off list price; Granite Pipe Co., M. V. Paige, 75 per cent.; Akron pipe F. A Lane, 73; Pike & Heald, 71½; F. D. Potter, 71; H. Fish, 71; Manchester Heating & Lighting Co., E. F. Higgins agent, 71; H. A. Warren, 70.

Excavation and Rip-Raps.—The contract for straightening Caldwell's run, excavating, rip-rap on the banks and placing bridges, has been awarded by the Board of Public Works, Wheeling, W. Va., to Paige, Carey & Co., of New York, on their lump bid of $8,000. They have the machinery and facilities on the ground, having already straightened a part of the run for the Union Bridge Co., and being now engaged in tunneling Chapline hill. The stone removed from the tunnel will be used for rip-rapping.

Street Work.—At Baltimore, Md., the following proposals have been received for grading, paving and curbing Mulberry St., between Mount St. and Fulton Ave.. Morgan & Brosnan, grading, 16 cts. per cu. yd.; curbing 40 cts. per lin. ft.; paving, 5 cts. per sq. ft. A. Snyder & Son, grading, 17 cts.; curbing, 38 cts.; paving, 5½ cts Patrick Keelty, grading, 17 cts.; curbing, 40 cts.; paving, 5½ cts. James P. McGovern, grading, 12½ cts.; curbing, 38 cts.; paving, 5 cts. George Uterbaugh, grading, 14 cts.; curbing, 40 cts.; paving, 5 cts. Thomas F. Locke, grading 14½ cts.; curbing, 38 cts.; paving, 5 cts.

At Topeka, Kan., the following contracts have been awarded; Crozier & Tulford, grading Topeka Ave., 25,000 cu. yds. at 24¾ cts. Pleasant Smith, grading Sixth St., 8,000 cu. yds. at 28 cts. Capital City Vitrified Brick & Paving Co., brick paving on Topeka Ave., 31,500 sq. yds. at $1.69; on Sixth Ave., 8,250 sq. yds. at $1.69; in the alley, 1,900 sq. yds. at $1.75. Mulvane & Kepley, curbing with Fort Collins (Col.) sandstone, 12,300 lin. ft. at 75 cts. The Barber Asphalt Paving Co., bid $2.80 per sq. yd. for work on Topeka Ave. and Sixth st; the engineer's estimate was $2.63 and the bid was rejected. Mr. Lewis Kingman is City Engineer.

At Oakland, Cal., the following bids have been received for work on Washington St.: Southern California Bituminous Paving Co., curbing, including corners, $1.15 per lin. ft.; culverts, $3 per lin. ft.; bituminous sand rock, with concrete, 24 cts. per sq. ft.; manhole covers, $6 each; covering basalt blocks with bitumen, 12 cts. per sq. ft.; dressing curbs, 25 cts. per lin. ft. E. R. Thomasen, curbing, $1.10 per lin. ft.; culverts, $2.80 per lin. ft.; raising manholes to grade, $40 each; bituminous sand rock, including grading, 24 cts. per sq. ft. Santa Cruz Rock Paving Co., regrading, concrete and paving with bituminous sand rock, 24 cts. per sq. ft.; curbing, $1.10 per lin. ft.; culverts, $2.75 per lin. ft.; iron covers for manhole flues, $2.75 each; bringing manhole and catch-basin covers to grade, $2 each; dressing granite curbs to surface, 30 cts. per lin ft.; covering basalt block gutters with bitumen, 14 cts. per sq. ft. Total, $18,200.

PROPOSALS OPEN.

Boilers.—Building and setting a new and resetting an old boiler. May 3. M. R. Thorp, Chief, Supply Division, Washington, D. C.

Buildings.—U. S. Postoffice and Custom House, etc., at Camden, N. J. May 26. James H. Windrum, Supervising Architect.

Artesian Well.—E. C. Baird, Village Recorder, Graceville, Minn.

Pipe.—Water pipe; 800 ft. of 12-in., 5,000 ft. of 6-in. Chas A. Judson, Superintendent of Water Works, Sandusky O. May 7.

Sewers.—Sections 4 and 5 of the Dorchester intercepting sewer; section 7 of south side and section 7 of the west side intercepting sewers. Wm Jackson, City Engineer Boston, Mass. May 7.

Asphalt Blocks.—Furnishing 100,000 asphalt roadway blocks. The District Commissioners, Washington, D. C May 7.

Granite Blocks.—Furnishing 200,000 paving blocks, 3½ to 4 ins. wide, 12 to 14 ins. long, 7½ to 8 ins. deep. Also 70,000 blocks, 3½ to 4 ins. wide, 5 to 8 ins. long, 5 to 6 ins. deep. Anthony Thurston, Superintendent of Streets, Fall River, Mass. May 7.

Street Work.—Regulating and granite block paving on concrete foundation. The Commissioner of Public Works, 31 Chambers St., New York City. May 8.

Dredging.—One contract for 16,900 cu. yds., and another for 54,500 cu. yds. The Docks Commissioners, Pier A. North River, New York City, May 9.

Electric Lighting.—For 5 years; 125 full arc or 160 half arc lamps. M. P. Conway, Chairman of Street Lighting Committee, Holyoke, Mass May 9.

Water-Works.—Trenching, laying and block-filling 1¼ miles of 6, 8, 10 and 12-in. cast-iron water pipe, 141 gates, 77 hydrants. Engineer, N. M. Tidd, of Boston. The Water Board, Reading, Mass. May 10.

Sewers.—About 30,000 ft of vitrified iron-stone pipe, 11 flush tanks, excavation, 35 bbls. Portland cement. W. H. Doane, City Clerk, Carson City, Nev. May 12.

Breakwater.—About 1,470 ft. Major M. B. Adams, U. S. Engineer Office, Oswego, N. Y. May 13.

Street Work.—Grading, fire-brick paving, etc. W. P. Rice, City Engineer, Cleveland, O. May 16.

Bridges.—Constructing 11 pair of steel plate girders for deck bridges of 40 ft. clear span. D. Pottinger, Chief Superintendent, Intercolonial Ry., Moncton, N. B. May 17.

Water-Works.—Daily capacity, 1,500,000 galls., cost not to exceed $50,000. The City Trustees, Santa Ana, Cal. May 19.

Sea Wall.—At Key West, Fla. N. H. Farquhar, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., May 21.

Steel Work.—Medina sandstone paving. W. P. Rice, City Engineer, Cleveland, O., May 22.

Trestle.—Wooden trestle, 534 ft. long. The County Commissioners, Terre Haute, Ind., May 30.

Jail.—The County Clerk, St. Augustine, Fla., June 3.

Sewers.—Plans and specifications on file. May 5. George E. Mann, City Engineer, Buffalo, N. Y.

Bridge.—Mason work and superstructure for the Stroudwater iron bridge; 50 ft. span, 24 ft. wide. May 12. I. F. Clark, Clerk, Deering, Me.

Sewers.—Specifications can be obtained from the Engineers, Isley & Cummings. May 12. I. F. Clark, Clerk, Deering, Me.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., report that they have delivered 27 engines during April: New York Central & Hudson River, 6 eight-wheel passenger engines, cylinders 19x24 ins., weight, 60 tons; Chicago & Northwestern, 13 ten-wheel freight engines, cylinders 19x24 ins., weight, 61 tons, and 4 six-wheel switch engines, cylinders 17x24 ins.; Hutchinson & Southern, 1 passenger engine, cylinders 18x24 ins.; Louisville, St. Louis & Texas, 1 six-wheel switch engine, cylinders 17x24 ins.; Troy Steel & Iron Co., 2 narrow gauge switch engines, cylinders 9x16 ins.

The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered a 65-ton engine to the Baltimore & Ohio. They are building 4 engines for the Birmingham, Sheffield & Tennessee; switch engines for Albright & Co., of Buffalo, N. Y.; and dummy engines for the Redondo Beach road, in California.

The Mason Machine Co., of Taunton, Mass., has sold an engine of the Mason-Fairlie steam truck type to the Old Colony. The engine was built to the order of the Atlantic & Ohio.

The Brooks Locomotive Works, of Dunkirk, N. Y., have delivered 15 engines to the Cleveland, Cincinnati, Chicago & St. Louis; this road is having 10 ten-wheel engines built driving wheels 66 ins. diameter. The works are said to have enough orders on hand to keep them running until 1891.

The Rogers Locomotive Works, of Paterson, N. J., have completed an engine for the Kansas City, Watkins & Gulf.

The Pittsburg Locomotive Works, of Pittsburg, Pa., have completed 5 passenger engines for the Vandalia.

The Union St. Ry. Co., of Atlanta, Ga., will probably operate its lines by dummies.

H. K. Porter & Co., Pittsburg, Pa., report that they are running full on orders for street motors, furnace engines, also light engines for coke works, coal mines and steel mills. They are building a number of logging locomotives, some freight and passenger engines, and have orders from Cuba and Mexico.

The Union Pacific Ry. has placed orders for 100 locomotives.

Cars.—The Pullman Palace Car Co. is building 2 drawing-room cars, 2 passenger cars and 2 combination cars for the Long Island. The road has placed orders for 100 cars. The works have delivered 20 passenger cars and a large number of gondolas to the Philadelphia & Reading. The former have the Baker heater. Hale & Kilburn car seat and pneumatic train signal. The latter are hopper gondolas of 70,000 lbs. capacity; 36 ft. long; they are equipped with air brakes, Butler drawbars and Van Dorston couplers.

The Wagner Palace Car Co., of Buffalo, N. Y., has an order for 8 parlor cars for the Central Vermont.

The Gilbert Car Manufacturing Co., of West Troy, N. Y., has an order for 8 saloon cars, 4 passenger cars, 2 buffet cars and 2 baggage cars for the Buenos Ayres & Ensenada Port Ry.

The Ohio Falls Car Works, of Jeffersonville, Ind., have an order for 6 passenger cars and 2 baggage cars for the Columbus, Shawnee & Hocking. The former will have Baker heaters, Mason car seats, and steel wheels.

The Ensign Car Co., of Huntington, Pa., has orders for 300 box cars for the Cleveland, Cincinnati, Chicago & St. Louis, and 1,000 cattle cars for the Canda Cattle Car Co.

The Michigan Car Co., of Detroit, Mich., has an order from the Burlington, Cedar Rapids & Northern for 25 refrigerator cars of the Standard Tiffany Refrigerator Car Co.'s patent, with Bosmann tanks. These cars are to be 34 ft. long and of 50,000 lbs. capacity.

The Middletown Car Works, of Middletown, Pa., have an order for 500 iron cars.

The Haskell & Barker Car Co, of Michigan City, Ind., has an order for 1,000 box cars for the Chicago, St. Paul & Kansas City.

The Union Pacific Ry. has given orders for the construction of new rolling stock amounting in the aggregate to several hundred thousand dollars. Besides 100 locomotives the requisition calls for 1,000 box cars, 400 stock cars, 650 coal cars, 450 furniture cars, 300 fruit cars, 60 cabooses, 6 chair and 6 baggage cars. The orders were distributed among Eastern works, so as to get them filled and deliveries made as soon as possible. The road has received six mail cars.

Stock Cars.—The Montgomery Palace Stock Car Co., of Chicago, Ill., has been incorporated by Geo. D. Baker, Jas. Montgomery and H. H. Peck. Capital stock, $5,000,000.

Railway Gates.—The plant of the pneumatic safety railway gate company will be moved from Chicago to Jonesville, a small town just south of Grand Rapids, Mich. A company has been formed with $300,000 capital, with J. A. McDonald at the head. The company has purchased 10 acres of ground, and willat once erect a foundry and macoine shops.

Car Wheels.—The Passumpsic and St. Johnsbury divisions of the Boston & Maine call from the shops at Lyndonville $2,000 worth of car wheels monthly. A freight car wheel costs about $11, and the axle the same, making a pair of wheels with the axle cost $33. A common passenger car wheel costs $12.50, while 36-in. steel wheels cost $53 each. The wheels weigh 600 and 650 lbs. each. A common engine driving wheel costs about $40, and the tire $50, exclusive of labor. A pair of driving wheels, with axle and labor, costs about $250. A car wheel is supposed to run about 50,000 miles on the average, though some of them run further. The company is said to have wheels which have been in constant service for 25 years.

Sewer Pipe.—The Sidney Sewer Pipe & Terra Cotta Co. has been organized at Seattle, Wash., by L. H. Wheeler and H. F. McClure. Capital stock, $50,000.

The Louisville Sewer Pipe Co. has offered to establish its works at Brazil, Ind., if that city will give a bonus.

The Spiral Weld Tube Co. has removed its sales office to 43 John St., New York City.

The Pulsometer Steam Pump Co., of New York, gives notice that it owns all the patents issued to C. H. Hall, which are the foundation patents on Pulsometer pumps, and the later patents for improvements on the same, issued to Gardner F. Badger.

The Ball Engine Co., of Erie, Pa., has opened an agency at Philadelphia.

Road Rollers.—After the trials of steam road rollers at Chicago on April 4, orders were given to W. C. Oastler of New York, by the Department of Public Works, Chicago, and the Commissioners of Lincoln Park, Chicago, for Aveling & Porter single cylinder double-speed steam road rollers.

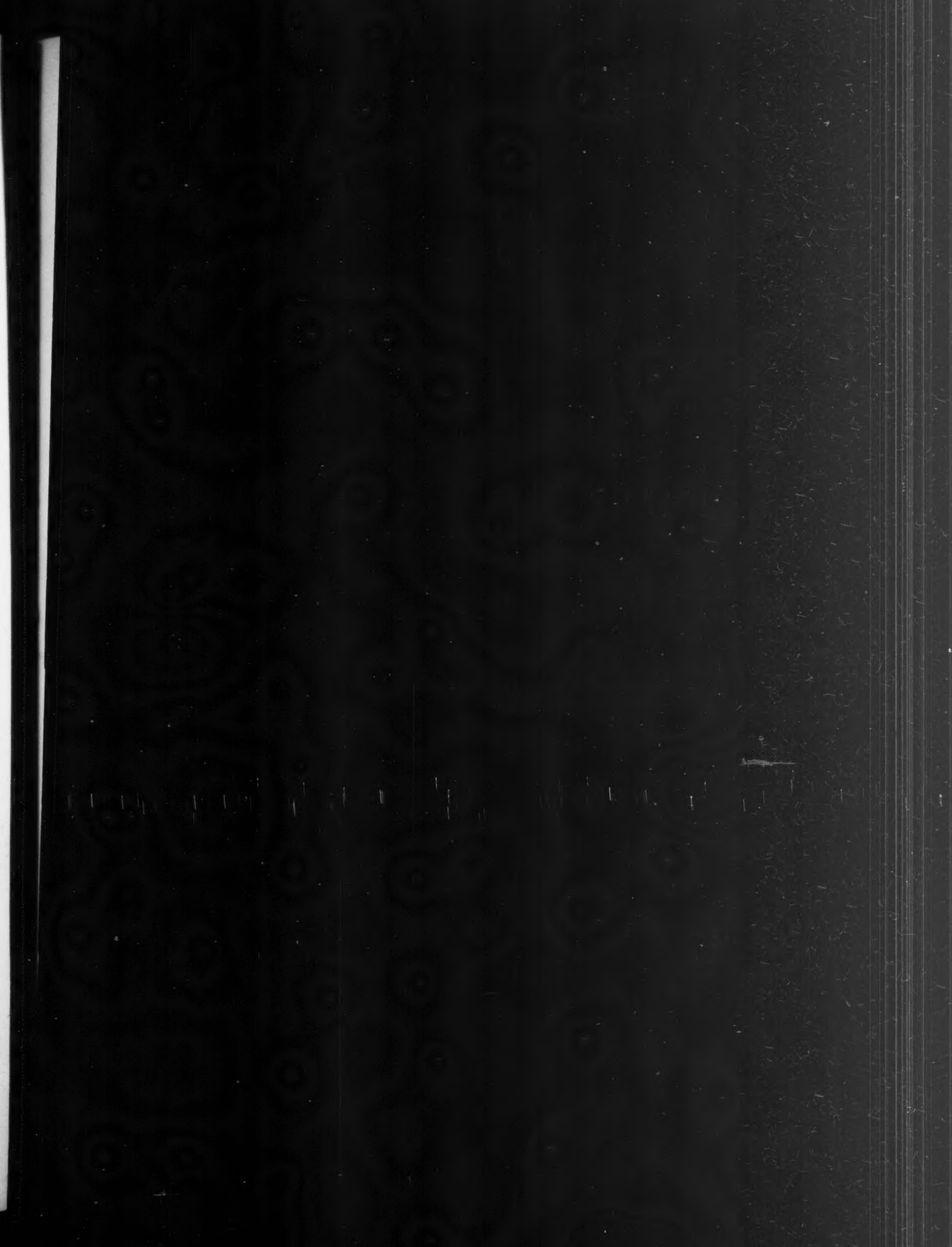
Filters.—The National Water Purifying Co. reports a second order received from the Oliver-Roberts Wire Co., of Pittsburgh, Pa., for additional filter plant of 500,000 galls. capacity.

The Higley Sawing & Drilling Machine Co. will move from 45 Broadway to 129 Worth St., New York.

Metal Market Prices.—*Rails.*—New York: weak at $33; old rails, $23, $23.50 to $24 for iron. Chicago: $35; old rails, $22.50 to $23 for iron, $19 to $20.50 for steel. Pittsburg: weak at $33 to $34; old rails, $23 to $24.50 for iron; $21 to to $22 for steel.

Track Materials.—New York: steel angle bars, 2.20 to 2.25 cts.; spikes, 2.05 to 2.10 cts.; track bolts, 2.05 to 2.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.10, or 2.20 cts. delivered at Chicago or St. Louis; track bolts, 2.85 to 2.90 cts., with square, and 2.95 to 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.25 cts. for steel, and 1.90 to 2 cts. for iron; spikes, 2.05 to 2.10 cts.; nut track bolts, 2.85 to 2.90 cts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 3.85 to 3.95 cts.; Chicago, 3.75 to 3.90 cts.; St. Louis, 3.75 cts.

Structural Materials.—Pittsburg: angles, 2.30 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plates, 2.40 cts.; refined bars, 1.95 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire-box; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.90 cts. for tank.